126
Re
BLM LIBRARY
88081782
AMERICAN
MANAGEMENT
SYSTEMS, INC.
LIBRARY
WSO LIBRARY

REFINEMENT OF FEASIBLE OPTIONS

for the

Bureau of Land Management

Deliverable 5.4

DRAFT

ADP Modernization Project

April, 1987

Contract: AA852-CT5-15

QA
76.9
.E95
R434
1987b

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

1987 MAY -5 AM 10:00

RECEIVED
CHEYENNE, WYOMING

#1592098328

ID: 88081782

QA
76.9
.E95
R434
1987b

REFINEMENT OF FEASIBLE OPTIONS

for the

Bureau of Land Management

Deliverable 5.4

DRAFT

ADP Modernization Project

April, 1987

Contract: AA852-CT5-15

BLM Library
Denver Federal Center
Bldg. 85, OC-521
P.O. Box 25047
Denver, CO 80225

TABLE OF CONTENTS

		PAGE
1.	INTRODUCTION	1-1
1.1	Overview and Purpose	1-1
1.2	Project History	1-2
1.3	Major BLM Initiatives Related to ADEMP	1-3
1.4	Methodology, Limitations, and Assumptions	1-7
1.5	Organization of this Document	1-9
2.	OVERVIEW	2-1
3.	TECHNICAL ARCHITECTURE ALTERNATIVES	3-1
3.1	Physical Computer and Data Distribution	3-2
3.1.1	Alternatives	3-3
3.1.2	Physical Computer and Data Distribution Alternatives Eliminated from Further Consideration	3-7
3.1.3	Evaluation Criteria for CPU Distribution	3-10
3.1.4	Evaluation of Physical Computer and Data Distribution Alternatives	3-13
3.1.5	Comparison of Alternatives	3-17
3.1.6	Summary and Recommendation for Physical Computer and Data Distribution Analysis	3-18
3.2	Level of CPU Specialization	3-19

4. ACQUISITION ALTERNATIVES 4-1

4.1 Alternatives 4-1
4.2 Alternatives Eliminated From Further Consideration . . . 4-5
4.3 Evaluation Criteria 4-7
4.4 Evaluation of Alternatives 4-8
4.5 Comparison of Alternatives 4-12
4.6 Summary and Recommendations 4-12

5. STANDARDS 5-1

5.1 Operating Systems Standards 5-2
5.2 Spacial Graphics Standards 5-8
5.3 Data Base Management System Standards 5-11
5.4 Communications Standards 5-15
5.5 Languages 5-19

6. ENSUING STEPS 6-1

6.1 The Workload Analysis Model 6-1
6.2 The Model's Application to CPU Sizing for BLM's Technical Architecture 6-2
6.3 Task 8 - The Economic Analysis 6-2
6.4 Remaining Tasks 6-3

1. INTRODUCTION

1.1 Overview and Purpose

This document analyzes the alternatives available to the Bureau of Land Management for modernizing its ADP technical architecture (i.e., the overall configuration of computer hardware, systems software, and communications networks that support the Bureau's operations). This analysis is part of the fifth major deliverable produced under American Management Systems' contract to support BLM's ADP Modernization Project, a multi-year effort to improve the Bureau's ADP capabilities.

During previous tasks, AMS presented BLM with alternatives for meeting BLM's needs for ADP and telecommunications support and a brief description of the evaluation criteria to be used in evaluating these alternatives. The chief purpose of this report is to further refine the alternative acquisition methods and alternative system architectures that are feasible for BLM given the constraints imposed by current system development initiatives, functional requirements for ADP support, and other factors. The results of this analysis will serve as input to Task 8, an Economic Analysis of the feasible alternatives.

Each alternative described in this report will be evaluated with respect to its ability to meet BLM's future workload and functional requirements. These were identified by AMS in the Workload Analysis for the Bureau of Land Management ADP Modernization Project, delivered to BLM March, 1986; the Functional Requirements Analysis for the Bureau of Land Managment ADP Modernization Project, delivered to BLM April, 1986; and the Discussion of Objectives, Constraints, and Implementation Considerations, delivered to BLM October, 1986.

This document assumes that the reader is familiar with the organization and mission of BLM. Readers unfamiliar with the Bureau may refer to the Task 1 deliverable of the ADP Modernization Study or documentation such as the BLM Annual Report (available from the BLM Office of Public Affairs) for further details.

1.2 Project History

The Bureau's ADP requirements are currently supported by a network of computers located primarily in the Denver Service Center (DSC) and State Offices. These systems are rapidly reaching capacity saturation as well as obsolescence. In addition, the Bureau uses computers owned by other organizations -- such as the U.S. Geological Survey, the Bureau of Reclamation, the Forest Service, and the Bonneville Power Administration -- to support specific applications on a timesharing basis. Not all of BLM's programmatic and management information requirements are being met by the current technical architecture (i.e., the hardware, systems software, network capabilities, and related facilities required to support BLM's ADP requirements). Several functional areas have been identified which would benefit from automation; and BLM has initiated certain projects, such as the Automated Land and Minerals Records System (ALMRS). The current ADP systems cannot accommodate these planned BLM applications.

For a detailed description of BLM's existing ADP capabilites, the reader is referred to Existing Capabilites for the Bureau of Land Management ADP Modernization Project, delivered to BLM by AMS June, 1986.

In order to upgrade its ADP capabilities, BLM's Division of Information Resources Management (WO-770) has procured the services of American Management Systems (AMS) to perform an ADP and Data Communications Modernization study (ADEMP). The project is intended to accomplish the following objectives:

- Define BLM's current and future functional requirements for ADP and data communications support.

- Document the capabilities of BLM's current hardware and software, and analyze any deficiencies in meeting current and

future requirements.

- Identify the most efficent and cost-effective ADP hardware, software, and data communications configuration based on a economic analysis of alternative concepts.

- Prepare a configuration management plan with which to control the acquisition and management of any needed hardware, software, and communications capabilities.

- Specify the technical requirements for any new ADP technology that BLM may elect to procure.

The ADEMP study provides a framework for all of BLM's data systems. It is the purpose of this study to ensure that all BLM current and future functional requirements are supported by an integrated ADP and data communications environment to the extent that is feasible. Figure 1-1 depicts the tasks to be performed under AMS' contract. AMS' work will be completed by the end of fiscal 1987, with new ADP equipment being installed beginning in approximately 1989. ← Sure hope this happens

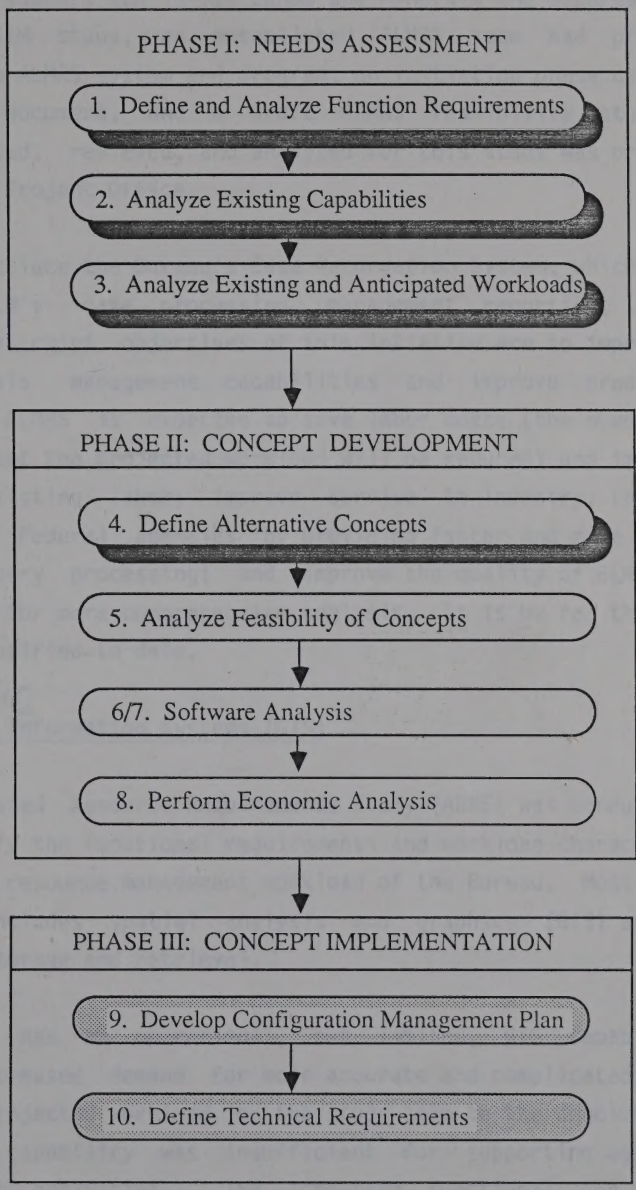
1.3 Major BLM Initiatives Related to ADEMP

The ADEMP Study addresses the hardware, system software, and data communications needs of all of BLM's current and future applications. A number of other studies were initiated by BLM to help identify and refine its ADP requirements for various programmatic or functional activities within the Bureau. They address automation of certain manual processes in case/operations processing, land and resource inventory and analysis, and administrative applications. These related projects and studies are being coordinated and integrated with the overall ADEMP study.

1.3.1 Automated Land and Minerals Record System (ALMRS)

In the beginning of FY 1984, the Federal Computer Performance Evaluation and Simulation Center (FEDSIM) was tasked by BLM to conduct a study

FIGURE 1 - 1: AMS has begun work on all Concept Development Tasks



to define the feasibility of, and the functional requirements for, an automated system to support BLM in its Lands and Minerals and Records mission. Prior to the FEDSIM study, an established ALMRS team had produced a description of the ALMRS system and program, an initiation phase document, a user requirements document, and a draft ALMRS feasibility study. The information collected, reviewed, and analyzed for this study was provided to FEDSIM by the ALMRS Project Office.

ALMRS will replace the Bureau's Case Recordation System, which does not meet all of BLM's case processing, management reporting, or query requirements. The chief objectives of this intiative are to improve BLM's Lands and Minerals management capabilities and improve productivity. Implementation of ALMRS is expected to save labor costs (the number of new hires required to meet the projected workload will be reduced) and improve the productivity of existing labor; improve service to industry, the general public, and other Federal agencies by providing faster and more efficient application and query processing; and improve the quality of BLM decision making by providing for more comprehensive analysis. It is by far the largest BLM application identified to date.

1.3.2 ~~Geological~~ Geographic Information Systems (GIS)

The Automated Resource Requirements Study (ARRS) was conducted by a BLM team to identify the functional requirements and workload characteristics for automating the resource management workload of the Bureau. Most resource management work includes spatial analysis and graphics (GIS) as well as alphanumeric data storage and retrieval.

BLM currently has an operational, but limited, GIS capability. A combination of increased demand for more accurate and complicated resource analysis and the projected workload led the study team to the conclusion that the existing GIS capability was insufficient for supporting agency-wide resource management activities. The long-term functional and workload requirements outlined in the ARRS study will be incorporated into the overall ADP planning effort.

1.3.3 Geographic Coordinate Data Base (GCDB) Study

BLM has documented the requirements for an integrated GCDB. This data base will store coordinate data for all lands under BLM's jurisdiction and will be used by both ALMRS and GIS as the basis of their applications.

1.3.4 Farmington Demonstration Project

The purpose of this project, initiated in March 1986, is to evaluate alternative concepts for integrating records (ALMRS), resources (GIS) and geographic coordinate data (GCDB) into a Land Information System (LIS). Through testing of various software alternatives, functional and system requirements related to LIS are being refined. Study findings will be incorporated into BLM's overall Modernization effort.

1.3.5 Office Automation

BLM currently has a contract with WANG Computers to support the Bureau's office automation needs. This contract is soon to expire. Rather than re-compete the contract, BLM has decided that office automation should be part of the overall technical architecture. Requirements for office automation are currently being determined by BLM and will be incorporated into the ADEMP project. MUST be compatible with ADP equip.; any other decision is foolish!!!

1.3.6 Eastern States GLO Records Project

The chief goals of this project are to develop an automated storage and retrieval system for the Eastern States Office's (ESO) public land records and to ensure that this public land data can be easily integrated into the ALMRS application. At present, BLM eastern and western offices use dissimilar methods for keeping public land records. ADEMP will address the needs of the ESO for a western states- and ALMRS-compatible public land and minerals records system.

1.4 Methodology, Limitations, and Assumptions

The objectives of this analysis are to:

- Refine the alternative technical architectures to those which could feasibly meet BLM's needs. The resulting set of feasible alternatives (those options which could meet BLM's ADP requirements) will be costed by Task 8, an Economic Analysis.

- Identify the alternative sources for acquiring the ADP resources required and provide a recommendation for the best means for acquisition.

- Specify the operating systems, data base management systems, application programming languages, graphics, and communications standards that should be incorporated into the Modernization hardware and system software procurement.

- Identify subsequent steps in the Modernization project.

The acquisition and technical architecture alternatives represent different ways to provide the functional capabilities required by BLM to accomplish its mission. The essense of the ADP modernization effort is to provide these functional capabilites to a geographically dispersed user community in the most effective way possible with commercially available ADP technology.

In a previous deliverable, Definition of Alternative Concepts for the Bureau of Land Management ADP Modernization Project, AMS presented BLM with the alternatives for meeting its needs for ADP and telecommunications support and a brief description of the criteria to be used in evaluating these alternatives. The objective of this report is to narrow those alternatives down to the point where economic factors are the only differentiating criteria.

There is no mention of the Prime computers that are currently in place; why not?

Our approach to refining both sets of alternatives (technical architecture and acquisition) was to identify the criteria that discriminate most sharply against the alternatives and evaluate the alternatives with respect to these criteria. The analysis of acquisition alternatives is performed independently of the analysis of technical architecture alternatives.

The central issue in selecting a system architecture is to determine the best way to distribute the control and physical location of the system's data. Thus, our approach to developing the set of system architecture alternatives was to investigate varying degress of data base and processing distribution. The alternatives range from a highly centralized architecture in which the data base storage and processing are performed at one location to a distibuted architecture in which processing and data storage is accomplished at the end-user locations. While the implementation of any one alternative may require consideration of several detailed design approaches, the alternatives presented here represent the general range of what is feasible given BLM's functional and technical requirements.

In developing the alternatives, we recognized that there are several automated systems which must be integrated into the overall ADP architecture. For example, BLM intends to begin design and construction of the Automated Lands and Minerals Records Systems (ALMRS) before the contract for ADP equipment from the ADP Modernization Study is awarded. In addition, BLM has major efforts underway for Geographic Information Systems (GIS) and a GeoCoordinate Data Base (GCDB).

This report does not specifically address central processing unit (CPU) sizing. Since only limited quantitative workload data is available at this time, we have only made qualitative observations (see AMS' Workload Analysis draft of March, 1986). We are currently collecting additional data which we will use in conjunction with a Workload Analysis Model to determine required system sizing. This information will be used in preparing Task 8's Economic Analysis.

1.5 Organization of this Document

In addition to this introduction, this document is divided into four chapters:

- **Chapter 2, Overview.** Chapter 2 summarizes the conclusions of this task and the implications for subsequent tasks of the ADP Modernization Project.

- **Chapter 3, Technical Architecture Alternatives.** Chapter 3 presents the first class of alternatives requiring analysis: those relating to the system architecture itself. Key criteria are identified and alternative architecures are analyzed with respect to how well they meet these criteria. Also discussed in this chapter is the level of computer processor specialization required in BLM's technical architecture.

- **Chapter 4, Acquisition Alternatives.** Chapter 4 identifies the alternative sources for acquiring the ADP resources for BLM's Modernization effort. Each alternative is evaluated with respect to how well it satisfies some key factors, which are also defined in this chapter.

- **Chapter 5, Standards.** Given the constraint that hardware and system software procurement for the major development efforts underway within BLM (e.g., ALMRS) will be initiated prior to the Modernization procurement, certain standards for system software were decided upon in order to enable coordination between efforts. Chapter 5 outlines the specific areas where standards were selected. A complete discussion is presented of all alternatives within each area.

- **Chapter 6, Ensuing Steps.** Chapter 6 outlines additional issues to be resolved. The Chapter includes a discussion of the Workload Analysis Model which will be used in determining required CPU capacity and the Economic Study which will analyze each technical architecture alternative defined in this report (with the results of the Workload Model incorporated) in economic terms.

2.0 OVERVIEW

The objective of the ADEMP project is to determine how to best meet BLM's future needs for ADP and telecommunications. The overall goal of this paper is to identify those alternative technical architecture configurations (i.e., in terms of computer equipment, systems software, and data communications equipment and software) which are technically feasible which can then be costed in Task 8 - the Economic Analysis. Acquisition and software standards issues are also addressed in this document.

BLM's objectives for ADP in general and the technical architecture in particular played a major role in determining which acquisition and technical architecture alternatives were feasible.

This document analyzes the technical architecture and acquisition alternatives available to BLM, presents a discussion of the software standards agreed upon for the ALMRS development project which will be incorporated into the overall Modernization effort, and outlines steps for further evaluation.

Based on our analysis to date, we have come to the following conclusions:

- A competitive procurement will provide the best means for acquiring the ADP and data communications hardware and system software required for the Bureau's ADP Modernization. No other alternative analyzed can provide BLM with a solution that will satisfy the Bureau's requirements for flexibility, integration of applications, and compatibility with existing systems.

- The key determining factor, with respect to physical computer and data distribution, is the cost of implementing the alternative configuration. The set of feasible technical architecture alternatives identified in this report will all be costed in Task 8, the Economic Analysis.

- Utilizing one product line of computers would provide BLM with the

ADP resources it requires to carry out its mission effectively. The level of integration among systems required by BLM can only be feasibly achieved by staying within a single, compatible product line. Whether there will be specialization within the product line will be addressed in Task 8, the Economic Analysis. Incorporating multiple, specialized computer processors from different vendors into BLM's technical architecture would only increase the cost and complexity (and thus, maintenance, support, problem identification and resolution, etc.) of the system.

Alternative sources analyzed for acquiring the ADP resources required for BLM's ADP Modernization were those identified in GSA's Federal Information Resources Management Regulations (FIRMR) in section 201-30.009. These included alternatives which assume the current systems are replaced as well as those which assume the current systems are not replaced (e.g., rearranging current ADP resources to improve current system utilization). AMS categorized these alternatives into three categories. These included alternatives involving the use of non-ADP resources, alternatives involving the use of other sources of ADP resources to augment existing capabilities, and alternatives involving the replacement of existing systems. Certain key factors such as flexibility, integration of applications, and compatibility with existing systems were utilized to evaluate the alternatives identified.

The next area addressed in this document concerns the technical architecture itself. Alternatives for the physical location of ADP resources and data were analyzed with respect to how well each matches BLM's organizational structure, satisfies BLM's needs for flexibility and reliability, and how much impact the technical architecture would have on BLM staffing and organizational structure. The alternatives evaluated vary in the extent to which each relies on communications technology. The level of CPU specialization is also discussed with respect to the type of computer systems (e.g., general purpose or specialized) necessary for BLM to carry out its responsibilities more effectively.

The BLM IRMTAC Subcommittee met with AMS February 11-13, 1987 to set various standards for the ALMRS development project. The purpose of this

meeting was to decide upon operating systems, spatial graphics, data base management systems, communications, and language standards for ALMRS. The major objective of setting these standards was to enable ALMRS application development to proceed before hardware and system software vendors/products have been selected for BLM's overall Modernization effort while minimizing the risk of incompatibility between ALMRS and the new technical architecture. A review of this meeting is presented in this paper.

Our next step is to determine the amount of computer processing capacity, based on the specific requirements of the current and future BLM applications, that will be required to support BLM in carrying out its mission. Some of these statistics have already been compiled and a preliminary estimate was presented in Task 3. The available workload statistics at that time were insufficient for compiling a quantitative estimate and we have since been gathering additional data on BLM's current and future workload. AMS will load the compiled workload statistics into a Workload Analysis Model; and for each alternative technical architecture defined in this document, predict the required CPU size, and the number of input/output channels and disk drives required to support BLM's workload. The results of this analysis will be used in a cost model to determine the cost for each technical architecture alternative.

Based on the results of the Economic Analysis, AMS will prepare an implementation plan addressing the procurement approach for the technical architecture, the overall schedule for acquisition and implementation, and the installation and phase-in approach. In conjunction with the development of the implementation plan, AMS will complete a Preparation of Specifications for the new technical architecture to be used in Section C of the Request for Proposals for the BLM technical architecture.

3. SYSTEM ARCHITECTURE ALTERNATIVES

The first class of alternatives requiring analysis involves the technical architecture of BLM's ADP system. As mentioned in the Task 4 deliverable, there are two issues to be addressed with respect to system architecture:

- **Physical Computer and Data Distibution.** This issue refers to the distribution of computer processors and data storage facilities throughout BLM. The alternatives for organizing ADP resources differ in the extent to which each relies on communications technology and end-user computing technology. At one extreme, a fully centralized system can be envisioned that enables all users to access common data bases residing at a single ADP facility (e.g., the Denver Service Center (DSC)) via terminals. At the other extreme, a distributed system can be envisioned in which all BLM offices have their own ADP facilities.

- **Level of CPU Specialization.** This issue refers to the types of processors to include in the system configuration. In addition to general-purpose computers, many computers are designed to be more efficient processing a specific application type (e.g., scientific or administrative). However, increased specialization can also complicate ADP management and support. Alternatives for specialization range from one line of general-purpose computers to highly specialized computers servicing specific areas.

This chapter does not address the size of the computers. A qualitative estimate of the required capacity was made in Task 3 based on the statistics available to date. Specific sizing requirements will be documented when the additional workload statistics currently being compiled are complete. AMS will use these workload factors in conjuction with a workload analysis model we developed in order to estimate CPU sizes and data communications traffic. This model is described in Chapter 6.

3.1 Physical Computer and Data Distribution

The location of the nodes where BLM data are stored and processed is the central issue in determining viable ADP architectural alternatives. The initial alternative set included:

- o Fully Centralized (DSC)
- o Centralized (DSC) plus State Offices
- o Central (DSC) plus State Offices plus District Offices
- o Central (DSC) plus State Offices plus all sites with workload over a pre-determined factor
- o All sites
- o Fully distributed

Although many different variations of centralization and decentralization are possible, we have narrowed the "analysis space" down (in section 3.1.2) to the four alternatives we believe will enable the Bureau to carry out its responsibilities effectively and more efficiently.

This section describes the alternatives available to BLM for physical computer and data distribution, why we recommend elimination of the fully centralized and fully distributed alternatives from the "analysis space", the criteria identified for evaluating the remaining alternatives defined, an evaluation of how well each of those alternatives satisfies each criterion, and a comparison of the alternatives.

The analysis in this section is based, in part, on ideas presented by Mudie and Schafer[1]. They outlined a methodolgy for determining the optimal

[1]Mudie, M.W. and Schafer, D.J. "An Information Technology Architecure for Change," IBM System Journal, Vol. 24, Nos. 3/4, 1985.

processing environment for an organization such as BLM, where flexibility, responsiveness to change, and cost effectiveness are important. Mudie and Schafer classify applications by two factors: application type (e.g., production processing, decision support, and office systems) and scope (e.g., organization-wide, departmental, single-user). With respect to BLM, departmental system characteristics referred to in their paper are equivalent to local offices. They stress the need for a technical architecture that can adequately support the needs of all types of applications (e.g., local as well as organization-wide) and the importance of the appropriate distribution of ADP control.

3.1.1 Alternatives for Physical Computer and Data Distribution

Six architectural alternatives were identified for initial consideration. Each represents a different approach to meeting BLM's operational requirements. Alternatives have been developed only to the detail necessary to evaluate the overall approach in terms of its ability to meet the functional and workload requirements identified earlier in the project. This section provides a description of the alternatives. The key criteria by which these will be evaluated are presented in section 3.1.3.

3.1.1.1 Fully Centralized

A fully centralized system is a technical architecture utilizing a very large, central computer facility containing all the computer equipment (i.e., CPUs, disk drives, tapes, plotters, printers, etc). The centralized computer facility would be located at DSC. Users access this central facility via local terminals connected to the central facility through a wide-area communications network.

Within each site, terminals would be connected to each other via a local communications network. This local network would include a gateway to the Wide Area Network.

Computer operations, support and maintenance would be concentrated at DSC. Software development, training, and hotline support would most likely

The Training function @ DSC was eliminated!

has not wanted this responsibility in the past; why would they now.

also be concentrated at DSC, (though it would not be constrained to be centrally located by the centralized architecture).

All interfaces to outside systems (e.g., U.S. Geological Survey, the Bureau of Reclamation, the Forest Service and the Bonneville Power Administration) and to other BLM sites would be performed through network gateways at DSC.

3.1.1.2 Centralized (DSC) Plus State Offices

With this architecture, a centralized computing facility would be maintained at DSC as well as decentralized computing facilities at each of BLM's twelve State offices. Each State office would have sufficient disk and processing capacity to handle their processing requirements as well as those of the District and Resource Area Offices (who will also be able to access DSC).

A Wide Area Network would be used to access information "local" to another field office. For example, sometimes work for one task is performed across BLM offices. Data may be created in one office which another office needs for processing. This second office would use the distributed processing capability to access the remote data (if they are allowed access to it, of course).

Within each District and Resource Area office, terminals would be connected to each other and the Wide Area Network through a Local Communications Network. The Wide Area Communications Network will provide access to the remote computing capability of the State offices in DSC.

The Denver Service Center would continue to perform BLM-wide administrative functions, and would have sufficient disk and processing capacity to satisfy its needs.

The size of the State Office computers may vary in accordance with the processing requirements of each State and its corresponding District and Resource Area Offices. Each computer, however, will be compatible at the

object code level (binary instructions that can be processed by a computer without any preliminary processing) and operating system level. This would allow BLM to achieve transparent software portability (the ability to move program source code from one computer to another, without conversion, and have that code execute to produce identical results on each computer). This is very important because not only does portability reduce or potentially eliminate the cost of converting software from one machine to another, it gives BLM the flexibility to install applications on computers of the appropriate size and power for each office without developing multiple implementations of the same application.

3.1.1.3 Centralized Plus State Offices Plus District Offices

This architectural alternative is similar to the one above with the exception that computing resources will also be located in District Offices.

3.1.1.4 Centralized Plus State Offices Plus All Sites With Workload Over a Pre-determined Factor

With this technical architecture, separate computer systems would be located at DSC, State Offices, and each District or Resource Area Office with more than a pre-determined workload. In addition to the workload statistics already compiled, more detailed data is in the process of being collected and analyzed. AMS will use the results of this analysis to determine the workload of each site and, under this alternative, would define a specific cut-off point for installing ADP resources at a site. Each site whose workload qualifies them for individual computing capabilities will have sufficient disk and processing capacity to handles both its needs and the needs of any smaller field offices that will be supported by its system.

A Wide Area Network would be used to access information residing on remote computers. DSC would still have responsibility for providing BLM-wide administrative functions and ADP support and would have sufficient computer resources for its ADP needs.

Within each site, terminals would be connected via a local communications network. For those sites with a computer, this network would provide users access to the local computing resources. For those sites without a computer, the Local Communications Network would provide access to the Wide Area Network, which would, in turn, allow users access to the remote computing facilities of higher offices.

As in the previous two alternatives, the size of the individual computer systems would vary in accordance with the workload of the site. Each computer system would be compatible so application and development software and data can be shared among BLM offices.

All interfaces to outside systems and to other BLM sites would be performed through the Wide Area Network.

3.1.1.5 All Sites

Within this architecture, ~~decentralized~~ distributed computer systems would be located in each Resource Area, District, and State Office; DSC; BIFC; and the BLM headquarters in Washington, D.C. Each computer system would have sufficient processing and storage capacity to process all local applications (i.e., development of a Resource Management Plan (RMP) by a Resource Office).

DSC would continue to provide BLM-wide administrative functions, and would have computer resources sufficient for its needs.

Within each site, terminals would be connected to each other and the local computer via a Local Area Communications Network. The separate computer systems would be connected via a Wide Area Network, accessed through a gateway from the individual Local Area Networks.

As with the preceding three alternatives, the size of the computers installed at each location would vary in accordance with the ADP requirements (workload) of each. AMS assumes that colocated offices will combine their computing requirements into a single, larger system. All computers will be compatible so they can share applications and development software and data.

All interfaces to outside systems and to other BLM sites would be performed through the Wide Area Network.

3.1.1.6 Fully Distributed (No DSC)

This architecture alternative is similar to the "All Sites" alternative except that there would be no central computing facility at DSC to provide BLM-wide administrative functions. However, there would be a computer at DSC to support DSC's own financial and personnel systems.

3.1.2 Physical Computer and Data Distribution Alternatives Eliminated From Further Consideration

Of the six alternatives outlined in the previous section only four merit detailed analysis. We recommend the elimination from consideration of the alternative of a centralized ADP distribution as well as the option involving the elimination of the Denver Service Center. One of the major points of the Mudie and Schafer paper is the importance of differentiating between organizations that are geared towards end-user computing and those geared towards traditional data processing activities. Within BLM, the emphasis is on end-user computing: most of the data is collected and used in the field offices and analysis of this data provides the basis for the Bureau's day-to-day operations. Neither of the two alternatives eliminated can provide a good "fit" for BLM.

3.1.2.1 Fully Centralized

BLM is a large organization with well-defined subunits and a decentralized management philosophy. The Bureau is divided into four levels (the Washington Office, 12 State Offices, approximately 50 District Offices, and about 160 Resource Area Offices) and each level of the organization has distinct responsibilities in implementing BLM's programs. An information system structure should be chosen that is consistent with the strategy, structure, and style components of the organization. If these components of the organization are ignored, two resulting effects significantly increase

risk:

- o Resistence to change, present in any organization, is increased
- o Factors which positively effect innovation are more likely to be omitted

Since the clear, tangible advantages of a centralized system over other alternatives are few, and the risk substantially higher, the fully centralized alternative should not be considered further.

The fully centralized option would greatly increase the inherent resistance to change. In a paper published by the Center for Information Systems Research in the Sloan School of Management at the Massachusetts Institute of Technology[2], the researchers found that in successful companies, data was managed from a business perspective, rather than a technical viewpoint. That is, physical distribution of data resources were justified by compelling business needs (e.g., coordination, flexibility) rather than by technical arguments. In BLM, each State Office, with its associated District and Resource Area Offices, function, in large, as separate units. The District and Resource Area Offices exist to support the State Offices in managing the lands under their jurisdiction. The authors stressed that the "recognition of the almost inevitable resistance to the implementations of actions which shift real or perceived power" in a organization is of the utmost importance. Since each State Office has full responsibility for the lands within its jurisdiction, they should also be given responsibility for control over their data, applications, and hardware. So, even though a centralized information structure is technically feasible, it would not provide a good "fit" for the agency.

Another important factor cited in the MIT paper that led AMS to the conclusion that a centralized ADP facility was not an acceptable alternative

---

[2]Goodhue, D., Quillard, J., Rockert, J., "The Management of Data: Preliminary Research Results", Center for Informations Systems Research, Massachusetts Institute of Technology, May, 1986.

involves innovation. As a Federal Agency, BLM is ultimately responsible to the public for its management of the Federal lands and resources within its jurisdiction. Innovations (e.g., taking advantage of the latest technologies) which allow the Bureau to carry out its responsibilities in the most efficient and cost effective way possible will be simpler and involve less risk if incorporated within a distributed technical architecture. The researchers cite several factors upon which successful diffusion of innovation is dependent. Among them are the observability of results (i.e., benefits) and the trialability or extent to which the innovation can be experimented with on a small scale, low risk basis. With a fully centralized technical architecture, any innovation would most likely require a major financial investment by BLM and "top to bottom" commitment in the Bureau to achieve results. With a distributed technical architecture, a State Office may experiment with the latest state-of-the-art technology (e.g., a new, high density storage device), or implement a new application. This innovation could then be implemented (or not) at other sites based upon its success (or failure).

3.1.2.2 Fully Distributed (No DSC)

The alternative involving the elimination of the Denver Service Center is also not in the best interests of BLM. There are obvious advantages of including a centralized ADP facility in BLM's technical architecture. These include economies of scale, sophistication of the systems environment, quality of systems development, and ADP cost control[3].

A common set of automated capabilities are required to support many of BLM's functions. There are approximately 60 Bureauwide applications used by BLM offices across the country (e.g., the Financial Management System, the Range Management Automated System, the Case Recordation System). DSC provides consolidated administrative support to all BLM offices and is also responsible for developing new scientific and technological systems for use in BLM

---

[3]King, J.L, and Kraemer, K.L., "Centralization Versus Decentralization of Computer Operations", Computers in Local Government. Auerbach Publishing, Inc., Vol. 3.1.5, pp. 1-10, 1985

offices. By providing BLM with a central data processing capability, BLM can recognize the economies of scale resulting from the sharing of resources. There are problems currently because many automation efforts are not shared enough. For example, ADP coordinators in some states were not aware of the work being done in other States. This results in a lot of duplication in effort. A fully distributed structure would only exacerbate these problems.

In addition, the Denver Federal Center (DFC) is the administrative data processing center for other Department of Interior (DOI) Bureaus with which BLM exchanges data. For example, the Bureau of Reclamation runs the PAY/PERS application at their facility in the DFC. And, systems sharing is likely to be increased in the future as DOI attempts to reduce the investment in redundant systems, so a central BLM ADP facility is a necessity.

3.1.3 Evaluation Criteria for CPU Distribution

This section presents the criteria by which the alternative hardware architectures will be evaluated. Several criteria were outlined in Chapter 5 of Task 4, Definition of Alternative Concepts. Certain of these criteria are most important to the objective of the ADP modernization effort and thus are used to evaluate the alternatives for the physical computer and data distribution. These include:

- o Matching configuration design to organizational design
- o Flexibility
- o Reliability
- o Staffing Impact, and
- o Organizational Impact

3.1.3.1 Matching Configuration Design to Organizational Design

A computerized information system design that is chosen to be

consonant with the strategy, structure, and style components of an organization can be expected to enable an organization to carry out its responsibilities more effectively. As mentioned in section 3.1.2.1, the ultimate goal of the technical architecture is to link ADP resources with the needs of the agency. Matching the configuration capabilities to the organizational structure may be an important factor.

BLM's organizational structure and management style is decentralized. Most of the Bureau's personnel and essentially all of its operations are located in field offices. There are 12 State Offices, each with responsibility for land in one to three states (with the exception of the Eastern States Office which is responsible for more than 30 states). Each State Office is supported by two to ten District Offices, which in turn oversee a variable amount of Resource Area Offices. Most direct operational functions are performed at the District and Resource Area levels.

In addition to its State, District, and Resource Area Offices, BLM also maintains a service center in Denver, Colorado; and has administrative responsibility for the Boise Interagency Fire Center.

BLM's field offices vary substantially in size and emphasis. In addition, different programs are emphasized in each State Office (and therefore their associated District and Resource Area Offices) depending on the resources found on the land they manage. For example, Colorado emphasizes minerals programs, while Oregon emphasizes forestry programs.

BLM is also responsible for providing selected ADP services (e.g., the Financial Management System) to the other Bureaus within DOI.

The technical architecture must allow local (e.g., State Offices, District Offices) users control over their data and applications. Matching the physical distribution to the organization is not synonomous to matching control to the organization. Theoretically, any configuration is capable of providing the necessary control given the correct policies. In practice though, this tends not to work --unless there is a very strong central management. To the end-user, the environment in which he works would appear

similiar regardless of whether the ADP resources were local or remote as long as the remote system was designed to ensure remote users appropriate and adequate control over their required ADP resources. But, if an organization could not obtain the control required by its users with a more centralized approach, then the physical parallelism (and thus a more distributed approach) to the organizational structure is necessary.

3.1.3.2 Flexibility

Flexibility refers to the capability of a resource to change or adjust to satisfy changes in users' requirements. Factors such as greater than anticipated growth in user interaction and the inability to accurately estimate workload because of the unavailability of system workload statistics make this a very critical criteria. If an office needs more/less computing power than originally planned for, BLM must be able to incorporate larger/smaller computer systems into the configuration.

3.1.3.3 Reliability

Reliability refers to the availability of a resource and the degree to which that resource performs its functions in the manner expected. Users must be able to access the ADP capabilities and complete their work.

In addition, software versions of applications and operating systems must be consistently maintained Bureau-wide. Hardware and software problems must be quickly resolved. Although part of the flexibility criteria, the availability of resources to meet user demand also effects reliability -- if services are not available as needed, then the system is not reliable.

3.1.3.4 Staffing Impact

Automation requires support of many kinds: software development, hardware and software maintenance, operations, data entry and validation, planning, user support, and countless other tasks. The staff needed for these tasks will change with the hardware architecture implemented.

This is an understatement

Any field office with a computer system must have the appropriate personnel necessary for supporting that computer system and its applications. The choice of a system architecture must take into account the level of support needed to operate and support that alternative. A key factor in determining the staffing requirements is the skill level of the personnel who will be maintaining the system. Staff must be trained in the operation and maintenance of the system. The time required by personnel in the field to perform necessary ADP functions will differ with each architectural alternative. Any office with a mainframe-based system will most likely require a dedicated staff of ADP professionals: operators, systems programmers, production support staff, etc. On the other hand, an office with an easy to maintain micro, super-micro, or mini-computer will not require a dedicated staff. However, even for small sites, it will still take time. Though clearly not a full-time job, ADP support will be at least a collateral duty.

This must include Dist. Offices & Resource Areas !!!

Amen! Amen!

BLM currently manages ADP and telecommunications out of the Denver Service Center and State Offices. Changes in the configuration may effect the current ADP organization. But even with a distributed ADP architecture, BLM will still need a user hot-line, communications specialists, etc. to isolate and resolve any technical problems beyond the scope of the local operators.

TRAINING!!!

3.1.3.5 Organizational Impact

Organizational changes or staffing requirements will vary depending upon the architectural alternative. Configuration management will be regulated at different levels within BLM depending on the physical distribution of computing resources. Management support of the hardware and software, from a centralized perspective, will also change based upon the technical architecture.

3.1.4 Evaluation of Physical Computer and Data Distribution Alternatives

The set of alternatives remaining to be analyzed include:

- Alternative 1 - Centralized (DSC) plus State Offices

- o Alternative 2 - Central (DSC) plus State Offices plus District Offices

- o Alternative 3 - Central (DSC) plus State Offices plus all sites with workload over a pre-determined factor

- o Alternative 4 - All sites

In the remainder of this section, each of the above alternatives will be evaluated with respect to how well each satisfies the criteria presented in the preceding section. Figure 3-1 summarizes how well each of these alternatives satisfies each criterion.

3.1.4.1 Alternative 1 - Centralized (DSC) plus State Offices

The physical distribution of ADP resources under this alternative would not mirror the physical organization of the Bureau. Most BLM operations are performed in District and Resource Area Offices. For example, District Offices are the primary level for economic and geological analysis, and Resource Area Offices are the primary level for the data collected for BLM to use in carrying out its mission. State Offices primarily provide administrative services to, and monitoring the work of, these District and Resource Area Offices.

The flexibility and reliability of this alternative is dependent upon both the specific equipment and software originally installed and commitment of ADP staff to maintain the types and levels of resources required by users.

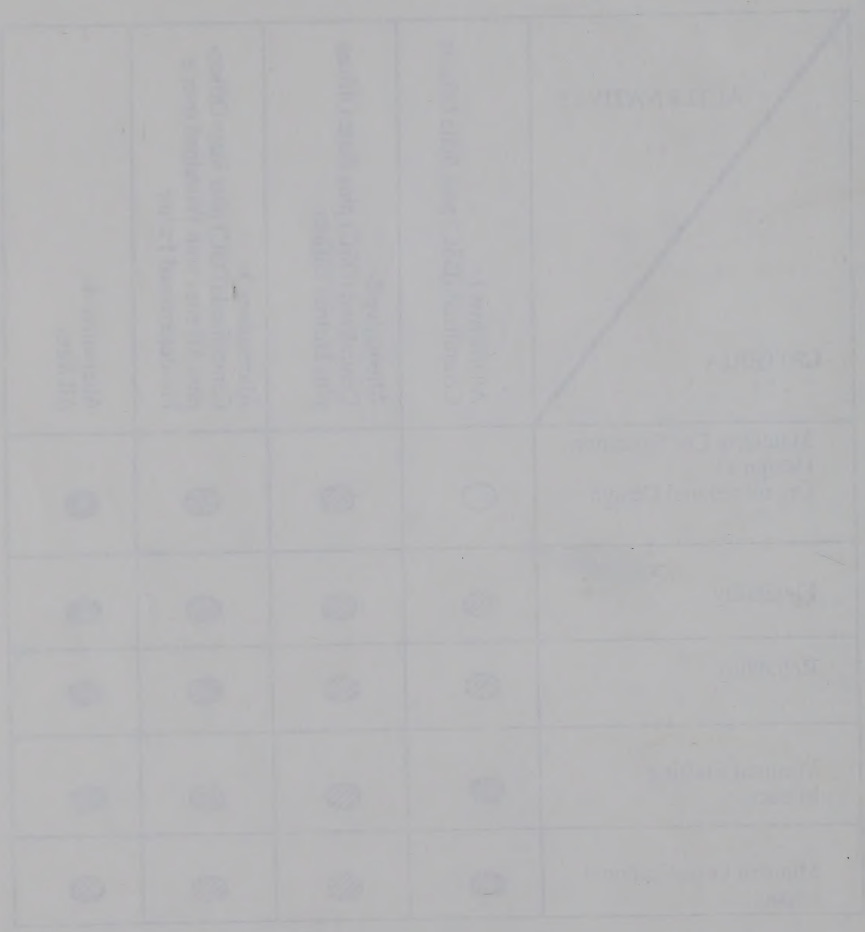
Placement of BLM staff would not be affected by a configuration with ADP facilities at DSC and the State Offices. This alternative mirrors the current ADP configuration. The precise staffing and organizational impact, in terms of number of staff required, can only be determined based upon the complexity of BLM's current and future applications and the complexity of the selected operating environment.

FIGURE 3-1

A Technical Architecture Extending to All Sites Best Satsifies the Criteria

CRITERIA \ ALTERNATIVES	Alternative 1- Centralized (DSC) plus State Offices	Alternative 2- Centralized (DSC) plus State Offices plus District Offices	Alternatives 3- Centralized (DSC) plus State Offices plus All sites with Workload over a Pre-determined Factor	Alternative 4- All Sites
Matching Configuration Design to Organizational Design	○	◍	◍	●
Flexibility	◍	◍	◍	●
Reliability	◍	◍	◍	●
Minimal Staffing Impact	●	◍	◍	◍
Minimal Organizational Impact	●	◍	◍	◍

KEY: ● Meets ◍ Partially meets ⊘ Barely meets ○ Does not meet



3.1.4.2 Alternative 2 - Central (DSC) plus State Offices plus District Offices

For the same reasons mentioned above for the preceding alternative, this alternative configuration would only partially meet the criteria for matching configuration design to organizational design. Although ADP facilities would be extended to another level in BLM where work is performed, all offices are still not covered.

As with the previous alternative, the flexibility and reliability of this alternative is dependent upon both the specific equipment and software originally installed and commitment of ADP staff to maintain the types and levels of resources required by users.

The precise staffing impact, in terms of number of staff required, can only be determined based upon each location's workload, and on the complexity of current and future applications and the selected operating environment. Some locations will have systems of sufficient complexity and size that they will require a full time staff to operate and maintain the system. On the other hand, some computer systems will be simple enough to operate and maintain that dedicated operators will not be needed at all. The users will be the system support staff and operators. Additional staff may be necessary for software distribution since there will be more sites at which to install software (e.g., applications, communications, operating system upgrades).

3.1.4.3 Alternative 3 - Central (DSC) plus State Offices plus All Sites With Workload Over a Pre-determined Factor

Of the 4 this is most suited to BLM needs!

This alternative configuration would also be partially consistent with BLM's structure. There would still be offices within the Bureau that perform work important to BLM's carrying out its mission, that would not be included in this configuration.

The flexibility and reliability of this alternative is dependent upon both the specific hardware and software originally installed and commitment of ADP staff to maintain the types and levels of resources required by users. As

in any configuration, satisfaction of both criteria depend on the available hardware and software resources.

As with the previous alternative, the staffing requirements can only be precisely defined when each location's workload, the complexity of current and future applications, and the operating system environment have been determined. In general, the more distibuted the technical architecture, the increased requirement for staff. While a full FTE would not be required at a small site with a simple computer system, maintenance and operation of the computer system would be at least a collateral duty. Management support of the hardware and software will have to be extended to all field offices to ensure system compatibility (e.g., that all systems are running the same application and operating system versions so data and applications are portable).

3.1.4.4 Alternative 4 - All sites

This alternative meets the criterion of matching the physical organization of ADP resources to stuctural organization of BLM's personnel resources. As mentioned previously, work is performed at all levels of the organization.

As with the above two alternatives, the flexibility and reliability is dependent upon the capabilities of the actual equipment and software acquired and the ability of BLM to continue to support users' needs.

The same staffing considerations that hold for the above alternatives also hold for this one. That is, the precise staffing impact, in terms of number of staff required, can only be determined based upon each location's workload, on the complexity of current and future applications, and the complexity of the selected operating environment and the ability of the existing staff to accept collateral duties.

3.1.5 Comparison of Alternatives

Each of the above alternatives have the potential to meet the ADP

requirements of BLM. The flexibility of any configuration is dependent upon the characteristics (i.e., how open the architecture is) of the system, not on the placement of the "pieces" that make up the system.

Staffing will also depend on the particular system installed. Economies of scale may be realized if the technical architecture included only DSC and State Offices because BLM would not need as much ADP operations support. On the other hand, some of the computing facilities will not require a dedicated staff of operators. The users will operate and support the system as a collateral duty. The more distributed the architecture, however, the more staff required to coordinate and control operations (e.g., software distribution to ensure that all systems have compatible capabilities, software updates, etc.). Regardless of the extent of distribution, a core of technical specialists will be required to isolate and resolve any complex problems.

3.1.6 Summary and Recommendation for Physical Computer and Data Distribution Analysis

One of the key requirements for BLM's technical architecture is to allow local (e.g., State Offices, etc.) users control over their data and applications. Each location must be ensured that appropriate and adequate computing power is available to them. The conceptual ADP system must be consonant with the strategy, structure and style components of BLM. This does not necessarily mean the physical distribution of the ADP system must mirror the physical distribution of BLM staff. Thus, the key issue with respect to the physical computer and data distribution is the amount of control that can be obtained within each architectural alternative. Theoretically, the same amount of control should be obtainable regardless of the extent of distribution of the technical architecture. A physical parallelism is only necessary if the level of control required cannot be provided.

The key determining factor, as far as configuration design goes, will be the cost of implementing each alternative. A more centralized approach may require less computer equipment, but it will also require faster, and more reliable telecommunications. All the the costs involved will be analyzed in depth in Task 8, the Economic Analysis of Alternative Configurations.

3.2 Level of CPU Specialization

Whether BLM's ADP needs will be met by a single line of general purpose systems or whether multiple, specialized systems are needed to allow BLM to effectively accomplish its mission is another issue which must be addressed. All elements of BLM's ADP structure must interact effectively and complement one another in order to successfully deliver the capabilties needed to support BLM activities.

Incorporating dissimilar, specialized computer systems into the technical architecture increases the number of vendors supporting it and thus increases the likelihood of obsolesence since vendors may not follow or support technical advances of other vendors. In addition, maintenance and support, user training, and problem identification and resolution will be much more complicated with multiple systems.

One of the major criterion of the technical architecture is that application software and data be portable (i.e., can run on, or be used by, any system that is part of the technical architecture). This objective would be more difficult to achieve (and more expensive to maintain) if there are dissimilar processors included in the technical architecture. The only way to achieve the level of integration required is to implement one product line of computers. Some of the computers within a given product line may be optimized for specific types of applications (e.g., spatial graphics).

In view of BLM's staffing constraints mentioned earlier, and economic factors, AMS does not recommend incorporating dissimilar, specialized systems in the ADP architecture. The need for a single, compatible product line is clear. Whether there will be some level of specialization within the product line will be addressed in the Economic Analysis (Task 8).

4. ACQUISITION ALTERNATIVES

The second class of alternatives requiring analysis involves the method of aquisition of the required ADP capabilities. Alternative sources for acquiring the ADP resources required are identified in the General Services Administration's Federal Information Resources Management Regulation (FIRMR) in section 201-30.009. These alternatives include both those which assume the current systems are not replaced and those which assume replacement of existing systems. Potential sources identified for analysis are categorized by AMS as:

- o Use of non-ADP resources
- o Use of other sources of ADP resources to augment existing capabilities, and
- o Replacement of the current ADP systems and office automation equipment

This chapter describes the acquisition alternatives available to BLM for the procurement of ADP equipment, the criteria identified for evaluating the alternatives defined, an evaluation of how well each alternative satisfies each criterion, a comparison of alternatives, and our recommendations for acquiring the ADP resources.

4.1 Alternatives

The alternatives presented in this section were identified by AMS in our Definition of Alternative Concepts for the Bureau of Land Mangement ADP Modernization Project, delivered to BLM August, 1986. These alternatives correspond to those specified in the FIRMR. For the readers convenience, they are re-presented below.

4.1.1 Use of non-ADP Resources

The non-ADP alternatives available to BLM are summarized into three areas:

- Rearranging current ADP resources to improve system utilization
- Developing improved manual procedures to reduce the need for ADP support, and
- Combining improved system utilization with improved manual procedures

Rearranging the current ADP resources includes activities such as revising the production schedule or job stream to improve computer utilization, balancing data storage to maximize the accessibility of disk space, and archiving old files to provide additional disk space.

Developing improved manual procedures to reduce the need for ADP support includes redesign of existing ADP procedures and development of new procedures so that reliance on the computer system is reduced.

Combining improved system utilization with improved manual procedures involves both rearranging current ADP resources to improve system utilization and developing improved manual procedures (e.g., adding or changing shifts to increase capacity). Rearrangement of resources will improve the system's ability to process a given system's workload and improved manual procedures will focus system resources where they are needed most.

4.1.2 Use of Other Sources of ADP Resources to Augment Existing Systems

BLM has several acquisition alternatives which use other sources to augment existing system's capabilities. These include:

- Using surplus equipment

- Use of timesharing services or facilities management services, and

- Expanding existing systems contracts to upgrade individual components of the current system to improve throughput capability

Surplus ADP equipment could be acquired from other DOI bureaus or other Government agencies. This equipment could be used to selectively improve the capability of specific locations as required. GSA publishes and distributes to Federal agencies a list of available excess ADP equipment. Interested agencies may obtain the equipment at a cost which is significantly less than the original equipment acquisition price.

Timesharing would allow BLM users to gain access to the computational services of an external computer system. Timeshare services could absorb some of BLM's applications or systems development work based on criteria set by BLM. This would release some of BLM's existing ADP capacity for other applications. Timeshare services can be obtained from either commercial vendors or from other Government facilities. The Multiple Award Services Contract (MASC) schedule provides Government agencies with a schedule of vendors qualified to provide timeshare support using a simplified procurement vehicle. In addition, Federal agencies can acquire commercial timesharing services through the General Service Administration's Teleprocessing Service Program (TSP). Timeshare services can also be obtained through a competitive procurement, typically using a Basic Ordering Agreement (BOA).

Facilities management services are similar to timesharing services in that an outside vendor manages some or all of an organizations computing resources. Timesharing utilizes a remote computing capability while facilities management involves outside support of computer resources on site. The vendor may own the resources and run them for an agency or the agency itself may own the hardware and the vendor runs it.

BLM Library
Denver Federal Center
Bldg. 85, OC-521
P.O. Box 25047
Denver, CO 80225

BLM Library
Denver Federal Center
Bldg. 85, OC-521
P.O. Box 25047
Denver, CO 80225

Expanding existing contracts would allow BLM to upgrade individual components of its systems to improve performance. Specific upgrades will most likely be limited by the terms of the contract.

4.1.3 Replacement of ADP Equipment

Under this alternative, the installed ADP system is replaced with an ADP system that will support BLM's functions. BLM has the following options under this alternative:

- o Acquire Government surplus equipment No way, Jose
- o Timeshare/Facilities Management Will not work well
- o Replace ADP systems with compatible systems that will handle the workload, and Yes
- o Competitive replacement of ADP system through use of functional specifications Yes

Acquiring government surplus equipment to replace BLM's existing ADP environment would be contingent on an entire "systems-worth" of ADP equipment being on the Availability List.

The timesharing/facilities management alternative would entail contracting with a remote computing agency to handle all of BLM's ADP needs. Feasibility would be limited by the existence of vendors who could provide all services required by BLM to perform its mission.

Replacement of the current ADP system with a compatible system that will handle the workload involves the aquisition of ADP equipment that is entirely compatible with the existing system. This implies that no conversion of applications and programs will be necessary. An example of this alternative would be replacing the existing computer systems with computers with increased capacity that can run all programs currently run on the existing systems.

Competitive replacement of the installed ADP system involves issuing a Request For Proposals (RFP). The RFP would outline the functional (and optionally, the technical) requirements which the system would need to satisfy.

4.2 Alternatives Eliminated From Further Consideration

Certain of the above-mentioned alternatives are eliminated from further consideration because they either fail to meet a mandatory requirement (e.g., ability to handle the current and future workload of BLM) or are clearly inferior to the other options (for reasons such as higher cost, larger risk, etc.). Those eliminated include:

- All alternatives falling in the "Use of non-ADP resources" category
- Those options involving the use of surplus equipment, and Not so hot!
- Those options involving the use of timeshare or facilities management services Poor alternative

4.2.1 All Alternatives Falling in the "Use of Non-ADP Resources" Category

The alternatives available to BLM which involve improving system utilization and/or developing improved manual procedures so there is less reliance on the ADP system clearly cannot meet BLM's future needs for ADP.

Even with the current ADP support, the workload is at times overwhelming. And, with the new systems developments (e.g., ALMRS, GIS) the workload will be significantly larger. Meeting the projected workloads under any of these alternatives would result in greatly increased labor costs due to the number of new hires required to handle the workload. This is an important factor since there is a lot of pressure on Federal agencies to cut back on staff rather than increase it. Cut backs are NOT the answer if we are to provide adequate service

In addition, none of these alternatives can result in improved service to industry and the general public because the available resources of the current ADP configurations will not be able to provide the capacity and performance required by BLM to process work faster and more efficiently.

4.2.2 Those Options Involving the Use of Surplus Equipment

Augmenting BLM's ADP resources with surplus equipment is not suitable for meeting BLM ADP requirements. The technical capabilities required for modernization could not be met by utilizing surplus equipment. BLM requires state-of-the-art systems for efficient processing.

The major purpose of modernization is to eliminate fragmented activities. Off-loading applications to yet another set of ADP equipment will not lead BLM any closer to a cohesive set of ADP capabilities. Replacing the entire existing ADP system with government surplus equipment would only be feasible if there was enough surplus equipment available from other agencies to put together an integrated system that could handle BLM's workload. Items on GSA's Availability List are generally single storage units or peripherals rather than complete hardware systems.

4.2.3 Those Options Involving the Use of Timeshare/Facilities Management Services

Contracting with a commercial vendor to augment existing ADP resources will not bring BLM any closer to its goal of an integrated ADP environment.

Unless a centralized approach is implemented for ADP resources, contracting with a commercial vendor to replace the current ADP environment is an unacceptable option. We discussed the viability of the centralized option in Chapter 3 and determined that a centralized ADP technical architecture was not feasible for BLM. It may make economical sense to hire a contractor to run and maintain the ADP resources of an organization if the organization has a centralized ADP environment. Maintaining a large, multi-mainframe-based computing facility requires a lot of manpower to support it (e.g., operate and

maintain the system, install software, and keep the operating system up-to-date) and timesharing/remote computing services may be economically attractive. It is not cost effective to utilize the management services of an outside vendor if computers are installed in a multitude of locations. For reasons outlined in Chapter 3, a centralized approach to ADP resources was determined to be unacceptable, thus eliminating this acquisition alternative as unacceptable, too.

4.3 Evaluation Criteria

AMS identified several evaluation criteria in the previously mentioned deliverable. Certain of these criteria are key to what BLM is trying to accomplish in its ADP modernization effort and thus are utilized to evaluate the remaining set of acquisition alternatives. Each of these clearly influences the feasibility of the acquisition alternatives for solving BLM's ADP needs. These include:

- o Flexibility
- o Integration of Applications, and
- o Compatibility with Existing Systems

4.3.1 Flexibility

The ADP system must have the flexibility to adapt to future needs and work loads. The system must be able to provide not only a near-term solution to BLM's ADP needs, but also be expandable to accomodate future program growth and new applications and permit movement of processing resources as required to support increased or decreased workload requirements.

4.3.2 Integration of Applications

One of the major purposes of the BLM Modernization initiative is to eliminate the duplication of effort and overlapping functions and to examine the potential of a fully integrated hardware, system software, and data communications environment. At present, BLM has a variety of applications

running on different vendor's systems. Many of these applications have common data sets; but since the systems are incompatible, the same information is being re-keyed. In addition, many of BLM applications utilize common processes (e.g., much of the software needed to provide for BLM's records functions have overlapping characteristics with the software required for resource functions).

Because of current system incompatiblities, there is much duplication in performing GIS activities (e.g., mapping and data collection policies). The ability to exchange data among systems will eliminate the duplication of effort, and thus should lead to increased productivity.

4.3.3 Compatibility With Existing Systems

If the new technical architecture is "compatible" with the existing BLM technical architecture, the time and cost incurred in moving to the new technical architecture will be decreased due to the reduction, or elimination, of a major conversion effort. Transportation of applications and data to dissimilar systems cannot be accomplished directly. Conversion of code, formats, etc. is required so the new system can "understand" the old data and programs.

4.4 Evaluation of Alternatives

The set of alternatives remaining to be analyzed include:

- Alternative 1 - Expansion of existing systems contracts to upgrade individual components of the current systems in order to improve throughput capability

- Alternative 2 - Replacment of existing ADP systems with a compatible systems that will handle the workload

- Alternative 3 - Competitive replacement of ADP system through the use of functional specifications

In the remainder of this section, each of the above alternatives will be evaluated with respect to how well each satisfies the criteria presented in the preceding section. Figure 4-1 summarizes how well each of these alternatives satisfy each criterion.

It should be noted here that within BLM, alternative 1 and 2 are functionally equivalent. Because there are no other vendor systems compatible with Honeywell systems, replacement of the whole system would have to be with Honeywell products. This would make the option of replacing the ADP systems with compatible systems functionally similar to expanding the current systems contract to upgrade the system to handle the workload.

4.4.1 Alternative 1 - Expansion of existing systems contracts to upgrade individual components of the current systems to improve throughput capability.

This is NOT a good long Term alternative

The capacity of the current systems contracts are such that the upgrading of individual components will not meet BLM's performance needs. BLM's current ADP facilities include many different (and largely incompatible) components. Expansion under the existing systems contracts would only serve to amplify the problems already stemming from incompatibility among BLM systems (e.g., major inefficiencies due to duplication of effort and overlapping functions). The modernization initiative was undertaken to ensure adequate automation support of current and future BLM mission requirements. And this includes eliminating the cost and processing inefficiencies resulting from incompatible systems. In addition, BLM's problems are not isolated such that a minor upgrade would suffice. They are wide-spread and encountered at virtually every computer site.

4.4.2 Alternative 2 - Replacment of existing ADP systems with a compatible systems that will handle the workload

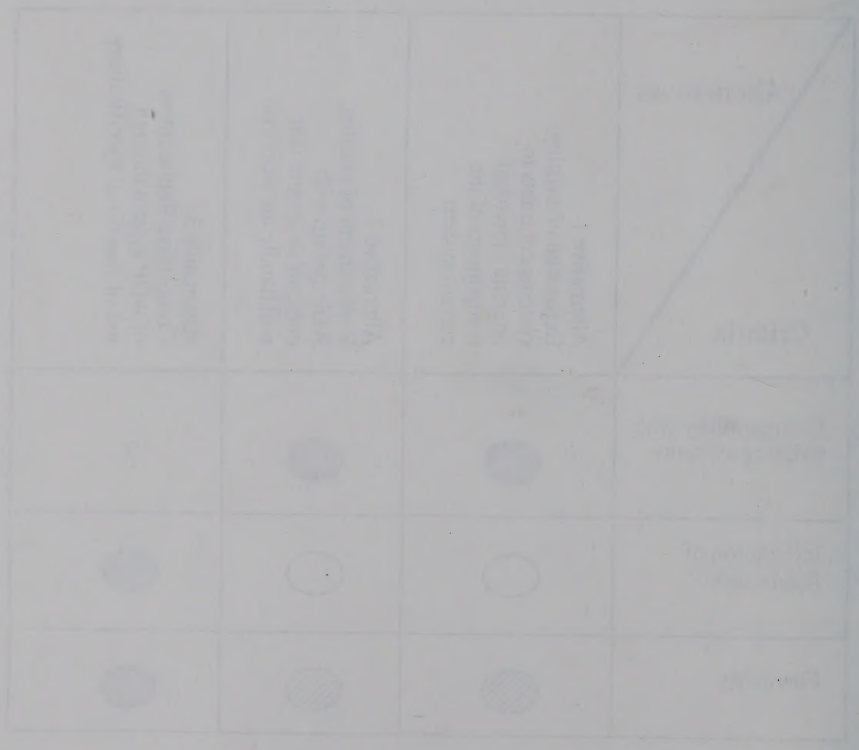
The new applications being developed (e.g., ALMRS, GIS) may require more resources than all of the existing applications combined. A compatibility-limited replacement will not satisfy the ADP requirements of the new systems.

FIGURE 4 - 1

A Competitive Procurement Provides the Best "Fit" for Acquisition of BLM's New Technical Architecture

Alternatives / Criteria	Alternative 1- Expansion of existing systems contracts to upgrade individual components of the current system	Alternative 2- Replacement of existing ADP system with compatible system that will handle the workload	Alternative 3- Competitive Replacement of ADP system through use of functional specifications
Compatibility with existing systems			?
Integration of Application			
Flexibility			

KEY: Meets Partially meets Barely meets Does not meet



This alternative would satisfy the criteria that the new technical architecture be compatible with the existing technical architecture, However, acquisition of larger, compatible systems that could run all the programs currently run on the systems they are replacing fails to meet the requirement for system compatibility "across the board". Systems integration is one of the major goals of the modernization effort, and by replacing dissimilar systems with systems compatible to each individual system will not solve BLM's problem of incompatibility across systems.

In addition, if BLM were to expand in such a way that existing applications are not to be affected, a sole source acquisition with Honeywell would be necessary since Honeywell compatibility would be required. This would limit BLM's ability to obtain discounts for ADP equipment and will probably not be approved for acquisition by GSA. Of equal, if not greater, importance is the fact that this alternative would result in a perceived restraint of competition.

4.4.3 Alternative 3 - Competitive replacement of ADP system through the use of functional specifications

Because a competitive procurement involves distributing an RFP outlining the functional -- and perhaps, technical - specifications which must be met by any proposed system, all criteria can be satisfied under this alternative. Submitted proposals must satisfy the requirements outlined in the RFP thus assuring (hopefully) BLM of an architecture/configuration that will meet the ADP requirements necessary for BLM to effectively and efficiently accomplish its mission.

In addition, a competitive procurement would allow BLM to take advantage of the large price reductions typically offered by vendors in a large scale competitive procurement.

It is not known at this time if under this alternative, the criteria of compatibility with existing systems will be met or not. Until a specific vendor is selected, the software migration effort cannot be determined.

4.5 Comparison of Alternatives

It is important to understand that, when evaluating alternative technical architectures, certain evaluation criteria are clearly important discriminators. That is, satisfaction of these criteria are critical to the success of the project. With respect to BLM's Modernization effort, the criteria for application integration is the key differentiating factor. Given this assumption, the alternative which best satisfies the evaluation criteria is to competitively procure an integrated ADP system based on BLM's functional and technical ADP requirements.

Expanding existing systems under current systems contracts or replacing existing systems with larger, compatible systems will not provide BLM with the flexibility or performance the Bureau needs in its ADP environment. Required system capacity will increase enormously due to the new system developments underway (e.g., ALMRS, GIS); and the capacity of the current systems are such that upgrade of individual components will not meet the required performance criteria.

The chief purpose of the modernization initiative is to ensure that ALL of BLM's systems (e.g., purely administrative systems, case/operations processing systems (such as ALMRS), and land and resource inventory and analysis systems (such as GIS)) are fully supported by an integrated ADP and data communications environment. The options of expanding existing resources or replacing them with compatible ones may solve future capacity problems, but will not provide for more efficient and cost effective ADP.

4.6 Summary and Recommendations

As described above, both alternatives 1 and 2 have fatal flaws which prevents them from being good feasible alternatives for acquiring ADP equipment. Neither provides for the integration of records, resources, and coordinate data. BLM's existing ADP facilities already include many different components which are, to a great extent, incompatible. Upgrading individual components or replacing all systems with larger, compatible systems will not alleviate any of the problems which currently exist (e.g., re-keying due to

the inability to share data or programs, necessity to manage multiple support teams and maintenance contracts, etc.).

AMS believes that the competitive procurement process is the best means for acquiring the ADP and data communications equipment required for BLM's ADP modernization. No other source can provide BLM with a solution that will satisfy the Bureau's needs for flexibility, compatibility, and performance.

Of course, if BLM elects to replace the existing system, there are other acquisition issues that must be resolved. These were outlined in the Definition of Alternative Concepts for the Bureau of Land Mangement ADP Modernization Project previously referenced and will be resolved as part of this project at a later date.

5.0 STANDARDS

Given the criteria that ALMRS development will proceed before the ADP Modernization hardware and software procurement, BLM (in conjunction with AMS) has selected standards for the ALMRS development which will be incorporated into the Modernization procurement. The major objective of setting these standards is to allow ALMRS application software development to proceed before hardware and system software vendors/products have been selected for ADP Modernization while minimizing the risk of incompatibility between the development environment and the environment provided by Modernization. Since any incompatibility will cause a conversion effort, with resulting costs, these standards will help reduce the implementation costs for ALMRS and Modernization.

This chapter presents the results of the BLM IRMTAC ~~Subcommittee~~ Committee Standards Meeting of February 11-13, 1987. AMS presented specific areas where standards should be defined in order to coordinate the ALMRS and ADP Modernization efforts. These included:

- Operating Systems Standards
- Spatial Graphics Standards
- Office Automation Standards
- Data Base Management Systems Standards
- Communications Standards, and
- Languages

For each area defined, AMS outlined the options available and the implications for each with respect to functionality, portability, flexibility (e.g., to incorporate new technologies and products or to expand or reconfigure to meet changing functional and workload requirements), life cycle costs (e.g., hardware, software development and maintenance, training, support), and risk (e.g., cost overrun, schedule slippage, procurement protest, obsolescence).

5.1 Operating Systems Standards

Operating systems are an integral part of the computing environment. They are the programs, implemented in either software or firmware, that make the hardware usable. Five options were outlined for operating system standards:

- o No standard
- o Vendor proprietary operating system
- o POSIX (proposed UNIX-like standard)
- o Vendor independent proprietary operating system (PICK)
- o Specified proprietary operating system

5.1.1 No Standard

Not good

Under the "no standard" option, the Modernization vendor would supply whatever operating system they felt best met the requirements of BLM, regardless of the ALMRS development environment.

The implications for this option are as follows:

- o **Functional** - Each vendor would be provided maximum flexibility to provide needed functionality and optimum performance in hardware and system software. It would be difficult, however, to achieve a single user interface. Data sharing among applications and sites would be significantly more difficult if multiple operating systems are used.

- o **Portability** - Unless there is a common operating system interface, applications cannot be moved between computer systems without requiring some conversion. For complex applications such as ALMRS and GIS, this conversion cost may be prohibitive. In addition, with no standard, vendors may elect to install multiple operating systems

within BLM (e.g. both Mod 400 and GCOS 8 or both VM and MVS), making conversion of ALMRS to the new environments even more time and money consuming.

- **Flexibility** - No standard will encourage vendors to propose and provide their own proprietary operating systems. These vendor proprietary operating systems may make incorporating new products and technologies difficult and more expensive thus complicating upgrade and expansion. Agree

- **Life Cycle Cost** - The initial acquisition cost may be minimized because the vendor will be providing an operating system of his choice. However, applications development and maintenance, training, and support will be higher if applications must be developed to work and users trained to work with multiple operating systems.

- **Risk** - If there is more than one operating system specified, this option has a high probability of cost overrun and schedule slippage due to the increased complexity of the total system. In addition, multiple operating systems increases the likelihood of obsolescence since some of the operating systems specified may not be maintained and upgraded to incorporate technical advances on a timely basis. With respect to procurement, not specifying a standard would lead to the maximum amount of competition and thus the minimum risk of protest.

5.1.2 Vendor Proprietary Operating System

The "vendor proprietary operating system" option would require vendors to provide a single operating system for all processors without specifying which one.

The implications for this option are as follows:

- **Functionality** - Under this approach, there are no functional or performance requirements that could not be met. In addition, it

would allow some vendors to offer a wider range of software and other products, though the availability of software would depend on the specific operating system.

- **Portability** - ALMRS would have to be converted from the environment in which it is developed to the one in which it would run.

- **Flexibility** - The incorporation of new technologies and products would depend on the specific vendor. Expansion and reconfiguration would depend on the parameters of the RFP.

- **Life Cycle Cost** - Under this alternative, there would be the potential for reduced hardware costs due to optimization. However, costs would be incurred for ALMRS conversion.

- **Risk** - Since this option entails a competitive procurement, there would be little risk of protest with respect to acquisition. Obsolescence would depend on the specific vendor.

5.1.3 POSIX

POSIX will support the execution of the same programs on various computers running different resident operating systems (i.e., portability). The POSIX standard is being developed by a committee working under the Institute of Electrical and Electronic Engineers (IEEE) and the National Board of Standards (NBS). When the standard is approved it is expected to be incorporated into the General Service Administration's (GSA) Federal Information Resources Management Regulations (FIRMR).

The UNIX operating system provides an interface for portable applications, but all versions of this operating system are proprietary and thus not available for standardization. The POSIX standard is expected to be approved in mid to late 1987. It is important to note that this standard is actually an operating system **interface** for portable applications. The initial standard only addresses applications written in the language "C". Portable applications can be written in other traditional languages, such as COBOL and

FORTRAN, but the language interfaces are implementation dependant. POSIX will provide the required functionality to support portable source code for a wide range of applications for various computers and operating systems. Because of the way the standard is being constructed, implementations may be done by methods the implementor finds will provide the needed functionality and optimum performance in hardware and system software.

The implications for this option are as follows:

- **Functionality** - This UNIX-like operating system will provide extensive capabilities for technical computing and office automation. The COBOL compilers currently available for UNIX-like systems are weak, but improvements can be expected. Because of the growing use of UNIX-like systems, many third party applications are being developed.

- **Portability** - ALMRS and other new BLM applications, if properly written, would only require recompilation. However, use of POSIX does not guarantee that applications are portable. Rigorous management control of programming styles and usage are necessary to ensure portability. For example, the "C" language allows the implementation of data pointer to vary on 16-bit, 32-bit, 36-bit, and 64-bit computers. Programs that make implicit assumptions about pointers will fail when moved to machines with differing architectures.

- **Flexibility** - The POSIX standard should cover a wide range of processor sizes so expansion and reconfiguration will be a simple matter. If POSIX gains wide acceptance, vendors will develop a lot of products that are compatible.

- **Life Cycle Cost** - The POSIX standard provides a highly productive software development environment because it allows for software portability. Conversion of properly written software (and its associated costs) are reduced or totally eliminated.

Not sure about what is being said of POSIX

- **Risk** - It is likely that POSIX will elicit a wide range of vendor support. Major vendors like AT&T, UNISYS, and DEC already support UNIX-like operating systems. If the standard becomes widely used and supported, the chance of obsolescence is negligible. There is a high risk for large COBOL applications since, at present, there are no strong COBOL compilers marketed for UNIX-based systems. Performance and availability for office automation and technical applications is good. If management controls are not enforced, there is significant risk that the portability advantages of POSIX will not be realized.

The specification of POSIX will have procurement implications that are not immediately apparent. The following discussion is from the National Bureau of Standards discussion paper titled POSIX: An emerging standard for (Applications) Software Portability:

> A benefit POSIX can not provide is to relieve the Federal Agencies of the important tasks of writing well thought out solicitations (RFI, RFC, RFP) and carefully evaluating proposed systems for their capability to meet specified requirements. A system which is POSIX conforming only insures that programs designed for portability to that standard will, in fact, run on that system. It does not promise any level of performance or guarentee any functionality beyond that specified in the standard.
>
> For those procurments where a benchmark is appropriate, the POSIX standard could potentially reduce the cost by making it easier to move the benchmark form one system to another. The costs may be lowered enough to allow benchmarks in some situations where it might have been marginally too expensive without the capability to easily transport the benchmark. The transportable benchmark will also facilitate benchmarking a real application as opposed to a synthetic benchmark whose results may be less reliable and less well understood. The closer one can come to running the application for which the system will be used, the higher confidence one can have that the system will indeed perform as required.

Due to probable wide variety of computer systems that will be used to support BLM applications during the ten year scope of Modernization, the ability to easily and inexpensively perform benchmarks will be a significant benifit.

5.1.4 Other Vendor Independent Operating System

Other operating systems are available (e.g., PICK) and may be specified in both the ALMRS and Modernization RFPs.

The implications for this option are as follows:

- **Functionality** - Depending on the specific software, there may be limited functionality, availability of third party software, and a limited number of processors on which the operating system software will run.

- **Portability** - ALMRS would be developed and ported to a new hardware environment without conversion, given that the hardware supported the specified proprietary operating system.

- **Flexibility** - This would be limited by the specific operating system.

- **Life Cycle Cost** - This would be determined also by the specific operating system acquired.

- **Risk** - Risk under this option would be high because there may not be wide-spread support of the operating system software.

5.1.5 Specified Proprietary Operating System

This sounds most plausible

Under this option, the ALMRS team would select the specific operating system best suited for the ALMRS application and which could support other BLM applications. Both the ALMRS RFP and the Modernization RFP would specify that particular operating system.

The implications for this option are as follows:

- **Functionality** - This alternative would provide the best fit of BLM application needs because it was actively selected as "best suited".

- **Portability** - All applications would be directly portable since the operating systems will be identical.

- **Flexibility** - Incorporation of new products and technologies would be dependent upon the operating system specified. Expansion and reconfiguration would depend on the parameters of the RFP.

- **Life Cycle Cost** - Initial acquisition cost may be high due to the absense of a competitive procurement.

- **Risk** - Software development risk is low, because the optimum operating system was selected. Procurement will most likely be protested or disapproved since a sole source award eliminates fair competition.

5.1.6 Operating System Resolution

The option proposed as a standard for all BLM field machines was the Portable Operating System for Computer Environments (POSIX) standard. The operating system for BLM-wide administravie applications was left open.

5.2 Spatial Graphics Standards

A large component of resource management work involves spatial analysis and graphics. Any system that is configured for use by resource specialists in BLM field offices must provide these capabilities. Thus setting a graphics standard is also important. The three options discussed were:

- No standard

- Graphical Kernal System (GKS)

- Others (e.g., PHHIGS, CORE)

5.2.1 No Standard

The "no standard" option would allow vendors to specify whatever graphics interface they considered would best meet BLM needs.

The implications for this option are as follows:

- **Functionality** - Since the vendor may specify the graphics interface he feels will best meet the requirements of the RFP, there are no limits on functionality. In addition, not having a standard graphics interface would allow for maximum use of third party software (e.g., GIS).

- **Portability** - New software drivers may have to be written for ALMRS to be run in a new environment.

- **Flexibility** - There is a limit to what technologies and products can work with non-standard software.

- **Life Cycle Cost** - Because there is a potential for high optimization, this option provides a low use of hardware resources. However, effort must be expended to develop graphics applications for custom applications such as ALMRS.

- **Risk** - The degree of risk is high because of the difficulty of writing graphics processing routines and the high probability that the system will be constrained to use specific hardware output devices.

5.2.2 Graphical Kernal System

The Graphical Kernal System specifies the interface between application programs and graphic input and output devices. It has been adopted as an American National Standards Institute (ANSI) and International Standards Organization (ISO) standard and is the most widely accepted of the graphics standards.

The implications for this option are as follows:

- **Functionality** - Some graphics functions are not included in this standard (e.g., 3-D, though it is under development). In addition, much GIS software (e.g., MOSS) does not comply with GKS.

- **Portability** - ALMRS graphics software could be ported to the new environment, and a variety of output devices, plotters, color CRTs, etc. can be used without change to the software.

- **Flexibility** - The use of GKS would facilitate adding new devices since standards are already specified. Software development may be constrained by the capabilities within the standard. These constraints can be overcome, but at the cost of additional development.

- **Life Cycle Cost** - Because a standard is specified, there may be reduced optimization and thus higher hardware resource requirements. However, resources will not have to be expended to develop graphics routines.

- **Risk** - In general, GKS minimizes risk by allowing ALMRS graphics to be developed in an industry standard, device independent method. There is a small risk, however, that GIS's spacial graphics requirements will exceed the capabilities of GKS, resulting in higher development costs.

5.2.3 Others

In addition to GKS, there are other graphics standards in use and under development. These include the Programmer's Hierarchical Interactive Graphics Standard (PHIGS), the CORE System, and the Initial Graphics Exchange Specification (IGES).

The implications for this option are as follows:

- **Functionality** - Each standard offers different functionality.

- **Portability** - Any which provided the features required by ALMRS would facilitate portability to the new environment.

- **Flexibility** - The extent of use and support of these standards is uncertain.

- **Life Cycle Cost** - As with the preceding alternative, because a standard is specified, there will most likely be reduced optimization and thus higher hardware resource requirements. Resources will not have to be expended to develop graphics routines.

- **Risk** - The risks associated with these other standards are similar to those discussed with GKS, but these standards are more specialized than GKS and may present additional costs if their capability diverges from the BLM requirements.

5.2.4 Graphics Resolution

It was proposed that GKS be used as a graphics presentation standard for ALMRS, but not for GIS.

5.3 Data Base Management System Standards

The data base management system (DBMS) is the software that handles all accesses to stored data files. A standard database management interface will allow BLM applications to share data. The four DBMS alternatives discussed were:

- No standard BAD
- Vendor specific package OK

- o Standard Query Language (SQL)

- o CODASYL

5.3.1 No Standard

BAD

Under the no standards option, the Modernization RFP would include a functional specification for a DBMS.

The implications for this option are as follows:

- o **Functionality** - Each application development project would select the DBMS package that is optimum. This would guarantee that the needed functionality is provided. This would not provide any guaranteed inter-application functionality.

- o **Portability** - The ALMRS software would have to be converted to use the DBMS acquired with the Modernization RFP (given that they are not the same).

- o **Flexibility** - With no standard, each application could possibly select their own optimal DBMS package, which would increase flexibility for that development effort. The use of conflicting DBMS packages for multiple packages would seriously inhibit the flexibility to share data and algorithms.

- o **Life Cycle Cost** - This option would entail ALMRS conversion costs if the Modernization DBMS package was different. However, there is the potential for reduced hardware costs due to optimization.

- o **Risk** - This option has the least risk for any given application development effort, but has unacceptably high risk for BLM as a whole.

5.3.2 Vendor Specific Package

Probably best

Under this alternative the ALMRS team would select the DBMS best suited for the ALMRS application and BLM would specify it in both the ALMRS and Modernization RFPs.

The implications for this option are as follows:

- **Functionality** - This option would provide an excellent functional fit as the vendor will select the DBMS that best meets the functional requirements of the RFP.

- **Portability** - The ALMRS portability objective would be met since the DBMS used in development would be the same used in the new environment.
- **Flexibility** - The incorporation of new technologies and products would be limited by the specifics of the DBMS.

- **Life Cycle Cost** - Hardware costs may potentially be lower due to optimization. However, initial procurement may be high due to the absense of a fully competitive procurement.

- **Risk** - Because a specific DBMS will be defined in the RFP, one or both procurements are likely to be disapproved or protested. Development risks are low because the ALMRS team would actively select the best package.

5.3.3 Standard Query Language

maybe

Under this alternative, vendors would specify any data base management package they felt could best meet BLM's needs on the condition that it support SQL. SQL was originally developed by IBM for use with their DB2 DBMS. It includes a user language and programming interface for relational data base management systems. Although implementations vary slightly, SQL has been adopted by many DBMS vendors (e.g., Cullinet, DEC, IBM, Oracle, Information Builders, Informix, Unify, etc.).

The implications for this option are as follows:

- **Functionality** - SQL provides all relational data management functions though it is inefficient for high volume transaction processing (which is not a major issue within BLM).

- **Portability** - The SQL interface would allow ALMRS to be ported directly to the new environment if the specific version of SQL was specified and enforced.

- **Flexibility** - SQL is becoming an industry standard and many new products (e.g., gateways to other packages) are being developed. The relational data model is the most flexible organization, with far better flexibility than hierarchical or network models.

- **Life Cycle Cost** - Hardware costs may be higher due to inefficiencies of some vendor's implementations.

- **Risk** - SQL is supported by a growing number of vendors. Since multiple vendors can provide BLM with SQL, there is little risk of a procurement protest. Deficiencies and limitations within the ANSI SQL specification require vendor extensions. Use of these extensions greatly increased risk and cost of conversion to new packages.

5.3.4 CODASYL

maybe

Under this alternative, a vendor may specify any database package that conforms with the CODASYL standard. The CODASYL standard is a standard for network data base design and does not handle relational data bases (which are far more flexible than network or hierarchically organized data bases) or include standards for user language or program interface.

The implications for this option are as follows:

- **Functionality** - CODASYL is designed for high volume, high performance production systems. Relational features are not addressed by the

CODASYL standards. The relational approach to data storage and manipulation is the most flexible of all possible approaches (i.e., relational, hierarchical, network).

- **Portability** - Data portability, but not application software portability, will be provided. Vendor specific implementations prohibit application portability.

- **Flexibility** - Within a given environment, CODASYL databases trade flexibility for performance. Vendor specific implementations seriously limit flexibility across vendor products.

- **Life Cycle Cost** - Hardware costs may be higher due to inefficiencies of some vendor's implementations. Software support cost will probably be significantly higher compared to a relational model.

- **Risk** - Because the CODASYL standard is really an architectural standard, each vendor's product, though it may conform to the CODASYL standard, will be vendor specific. This greatly increases the risk and cost of conversions to new packages. In addition, a network organization is much more complex than a hierarchical organization, and would be much more difficult for programmers to work with; thus increasing the risk of inefficient application development.

5.3.5 DBMS Resolution

It was proposed that SQL be designated as the standard interface for the ALMRS development effort.

5.4 Communiations Standards

There were three options available with respect to communications. These included:

- No standard

- o Transmissions Control Package/Internet Protocol (TCP/IP)

- o International Standards Organizations/Open Systems Interconnect (ISO/OSI) Standard

5.4.1 No Standard

Under the "no standard" option, the vendors would specify the communication protocols they felt best meet the requirements of BLM.

The implications for this option are as follows:

- o **Functionality** - Vendor specified communications software might provide BLM with maximum functionality (due to optimization) initially, but functionality may be limited if the communications specified is not widely supported because it would be difficult to incorporate advances in communications technology and to achieve an interface between a non-standard communications network and outside systems.

- o **Portability** - The ability to port applications and databases between dissimilar systems would be limited.

- o **Flexibility** - Lack of a standard will encourage vendor proprietary communications systems (e.g., IBM's SNA, Digital Equipment Corporation's DECNet, etc.). There may not be a wide variety of products available for communications between these proprietary systems. In addition, the use of non-standardized communications products could lock BLM out of technical advances in communications.

- o **Life Cycle Cost** - Because there are less products available for less supported communications, there may be costs associated with custom development of required communications extensions. Custom development and support of communications software would be prohibitively expensive. In addition, if BLM has to support more than one communications network, two or more separate support staffs

may be necessary.

- **Risk** - The risk of obsolescence would be very high with a non-standard communications system.

5.4.2 TCP/IP

Good

TCP/IP is widely used in the network marketplace. It is the only proven communications protocol that can provide inter-operability between dissimilar systems. This standard was originally developed by the Department of Defense Advanced Research Projects Agency (DARPA) to link its various systems and has since been refined.

The implications for this option are as follows:

- **Functionality** - TCP/IP supports a host of network applications including Network File Transfer for moving files across the network, Network Virtual Terminal for remote terminal traffic, Simple Mail Transmission Protocol for sending electronic mail packets, and Sockets for task to task communications such as mainframe to mainframe processing.

- **Portability** - TCP/IP can provide interoperability between dissimilar computer systems.

- **Flexibility** - TCP/IP is not proprietary. It is supported by a growing number of vendors. In addition, it can run side by side with other communications protocols (e.g., OSI), allowing great flexibility.

- **Life Cycle Cost** - More than 300 vendors support TCP/IP, thus initial procurement and maintenance costs can be expected to be lower (due to competition).

- **Risk** - There is little risk associated with this alternative as the protocol has been widely tested.

5.4.3 ISO/OSI maybe

The International Standards Organization created the OSI model based upon seven "layers" of communications: physical, data link, network, transport, session, presentation, and application. The purpose of these seven layers is to define the various functions that must be carried out when two machines communicate.

The implications for this option are as follows:

- **Functionality** - Standards for the first four layers are generally accepted but standards for the remaining of three layers are still under development. Because of this, viable commercial products based on OSI standards are still at least two years away.

- **Portability** - Once ISO/OSI is fully implemented, portability of data will be greatly simplified.

- **Flexibility** - Vendor support for the forthcoming ISO/OSI standard will provide a wide variety of hardware and software from which BLM could choose.

- **Life Cycle Cost** - This cannot be predicted at this time as there are no commercially marketed complete ISO/OSI products available at this time.

- **Risk** - Risk is high today because the standard is not complete. When all standards are finalized, risk will be very low.

5.4.4 Communications Resolution

Because TCP/IP standards offer vendor independence and connectivity for dissimilar machines today, it was proposed that BLM specify TCP/IP as their communications standard and migrate to ISO/OSI when OSI standards are fully developed and accepted. Migration to OSI from TCP/IP is possible through standard network interfaces (e.g., IBM's NetBIOS).

5.5 Languages

AMS and BLM also discussed which language interpreters or compilers the new technical architecture must support. These include languages which currently play a role in BLM applications. Selection of supported compilers did not require the in-depth analysis of alternatives as did the other issues discussed in this chapter. Thus, only the results of this discussion are presented here.

It was proposed that the technical architecture support the following programming languages:

- BASIC
- C
- COBOL 74 and 8X
- FORTRAN 77 and 8X

agree

Other languages the architecture must be capable of supporting for possible incorporation at at later date include:

- PASCAL
- LISP
- PROLOGUE

maybe

6. ENSUING STEPS

The next task facing the AMS project team is to perform a detailed analysis of the costs and benefits of the technical architecture alternatives presented in this report and the cost of telecommunications for each. The project team will present technical architecture recommendations at the comclusion of this analysis. We intend to use a Workload Analysis Model to predict the CPU sizes, the number of input/output channels, and the number of disk drives necessary for each alternative configuration identified in Chapter 4 of this report. These figures will then be input into a cost model developed by AMS to determine the approximate cost of each alternative to be used in Task 8's Economic Analysis.

6.1 The Workload Analysis Model

AMS will model each alternative configuration to estimate the processing resources necessary. The model we will use is a combination of the public domain CP80 sizing model (developed by IBM) and an AMS proprietary model. The CP80 model estimates CPU size, number of Input/Output (I/O) channels, and required Direct Access Storage Device (DASD) capacity given a situation-specific set of parameters called R-factors. The R-factors supply the CP80 model with information about application demands and system demands for CPU cycles and I/O. Empirically determined algorithms are used to translate these CPU and I/O demands given by the R-factors into estimates for CPU, I/O channel, and DASD sizing.

AMS has developed a portion of the sizing model which transforms estimates of transaction volumes, transaction complexity, batch processing workloads, and desired peak CPU workload into the R-factors needed by the CP80 model. We have simplified the determination of the R-factors by allowing the computing resource estimate to be stated in terms of average and peak transaction rates for on-line resources and file size, and processing window for file driven (batch) processes. Transaction rates are divided into three categories of complexity -- simple, average, and complex -- based on the average CPU and average physical I/Os performed by the transaction. Batch

processes are also categorized based on average CPU cycles and average number of I/Os per record. Based on the transaction counts given in the batch processing and on-line processing volume estimates, the AMS model calculates the R-factors for the CP80 model.

6.2 The Model's Application to CPU Sizing for BLM's Technical Architecture

AMS has been collecting all of the data necessary to feed into our model in order to generate the above-mentioned R-factors needed by the CP80 sizing model. The results of the modeling process estimate sizing for an IBM configuration. These results are then extrapolated to other vendor configurations.

6.3 Task 8 - The Economic Analysis

The purpose of Task 8 is to recommend an effective technical architecture which identifies the best overall approach to implementing a modernized ADP technical architecture.

The technical architecture alternatives to be considered in Task 8 are those defined in Chapter 4 of this document. Each alternative will be defined in terms of its potential benefits to BLM, weaknesses, key dependencies, major cost drivers, and implications for the Bureau.

In order to estimate technical architecture costs for each configuration, AMS will model each architecture using the Workload Analysis Model described in section 6.1. Industry sources will be used to determine representative costs for the different architecture components (including telecommunications costs).

Issues addressed in Task 8 include:

- The location of computing resources (alternative configurations identified in this paper)

- o Local office architecture (e.g., single processor, multiple processor, networking approach), and

- o Wide area communications

Costs will be estimated for each alternative technical architecture broken down by:

- o Baseline (based on initial workload) vs. maximum projected workload

- o Type of office (small vs. medium vs. large)

- o Cost component (e.g., wide area communications, processor, terminal, etc.)

- o Application (e.g., ALMRS, OA, Admin, etc.)

6.4 Remaining Tasks

Based on the results of Task 8, AMS will develop a high level action plan for implementing the selected technical architecture. This plan, Task 9, will address the acquisition approach for the technical architecture, the overall schedule for procurement and implementation, and the installation and phase-in approach.

In parallel with the development of the Implementation Plan, AMS will develop the technical specifications BLM will need to develop the RFP(s) to procure the selected technical architecture. This will be presented to BLM as Task 10.

The schedule for this study calls for all tasks to be completed by the end of FY 1987.

Memorandum

To: Director, (770), Room 108, Premier Building

From: State Director, Wyoming

Subject: Comments to the AMD ADP Modernization Study--Refinement of Feasible Options (Deliverable 5.4)

We have reviewed the subject document and are including comments we feel are pertinent. The following is a summary of our comments on an item-by-item basis:

1. Item 1.2 Project History--Your target date of 1989 for installation of new equipment seems optimistic, but we would be pleased if that delivery date can be achieved.

2. Item 1.3.2 Geological Information Systems (GIS)--The item heading should read "Geographical" instead of "Geological". This item underplays the alphanumeric data storage and analysis requirements; i.e., individual oil and gas well records, coal drill hole records, etc.

3. Item 1.3.5 Office Automation--The current Wang contract is for Word Processing. It is too limited to be called an Office Automation System. We also feel that OA must be compatible with existing and future ADP equipment.

4. Item 1.4 Methodology, Limitations, and Assumption--We wonder why the third objective of the analysis does not mention Office Automation equipment, although Prime computers are already installed in several BLM State Offices.

5. Chapter 2.0, OVERVIEW--No reference or discussion of Office Automation is made and we feel that it should include OA. In reference to page 2-3, the Information Resources Management--Tactical Advisory Committee (IRM TAC) does not have the expertise to set standards for the systems listed at the top of this page.

6. Chapter 3, SYSTEM ARCHITECTURE ALTERNATIVES--This does not consider Micro vs. Minis or smart work stations.

Memorandum

To: Director, (770), Room 108, Premier Building

From: State Director, Wyoming

Subject: Comments to the AMD ADP Modernization Study--Refinement of Feasible Options (Deliverable 3.4)

We have reviewed the subject document and are including comments we feel are pertinent. The following is a summary of our comments on an item-by-item basis:

1. Item I.2 Project History--Your target date of 1983 for installation of new equipment seems optimistic, but we would be pleased if that delivery date can be achieved.

2. Item I.3.2 Geological Information Systems (GIS)--The item heading should read "Geographical" instead of "Geological". This item underplays the alphanumeric data storage and analysis requirements; i.e., individual oil and gas well records, coal drill hole records, etc.

3. Item I.3.3 Office Automation--The current Wang contract is for Word Processing. It is too limited to be called an Office Automation System. We also feel that OA must be compatible with existing and future ADP equipment.

4. Item I.4 Methodology, Limitations, and Assumption--We wonder why the third objective of the analysis does not mention Office Automation equipment, although Prime computers are already installed in several BLM State Offices.

5. Chapter 2.0, OVERVIEW--No reference or discussion of Office Automation is made and we feel that it should include OA. In reference to page 2-3, the Information Resources Management--Tactical Advisory Committee (IRM TAC) does not have the expertise to set standards for the systems listed at the top of this page.

6. Chapter 3, SYSTEM ARCHITECTURE ALTERNATIVES--This does not consider Micro vs. Mini or smart work stations.

7. Item 3.1.1.1 Fully Centralized--In the past, the Denver Service Center has had the responsibility for training and hotline support, but apparently no longer wants that responsibility. The DSC had a function called the Customer Support Branch, but that was abolished in 1986. Nevertheless, the Service Center would be the most logical candidate to fill this important function.

8. Item 3.1.3.1 Matching Configuration Design to Organizational Design--(Paragraph 4, Page 3.11)--This is a good concept to make the system work in BLM.

9. Item 3.1.3.2 Flexibility--What about networking and sharing CPU's?

10. Item 3.1.3.4 Staffing Impact--To say that field offices must have appropriate personnel to support the computer system is an understatement. District Offices and Resource Areas must also be included and we agree that a dedicated staff is required. The third paragraph does not mention training.

11. Item 3.1.4 Evaluation of Physical Computer and Data Distribution Alternatives--We feel that Alternative 3 is the best.

12. Item 3.1.4.3 Alternative 3 - Central (DSC) plus State Offices plus All Sites With Workload Over a Pre-determined Factor--We feel that Alternative 3 is best suited for BLM needs.

13. Item 3.1.5 Comparison of Alternatives--In the second paragraph, we would be cautious of end-users assuming operator responsibilities on a collateral basis.

14. Item 3.2 Level of CPU Specialization--In the first paragraph, we feel that multiple, specialized systems are needed and again, OA is not mentioned. The second paragraph mentions training and we support that idea. In the third paragraph, we feel it would be possible to go with full, open procurement, and that "product line" is a poor term. Procurement will never allow one product line.

15. Chapter 4, ACQUISITION ALTERNATIVES--The second paragraph does not include OA.

16. Item 4.1.2 Use of Other Sources of ADP Resources to Augment Existing Systems--The first paragraph mentions surplus equipment. We would like to mention that, in most cases, used equipment leads to higher maintenance costs than prices for new technology. Also, parts are very often difficult to find.

17. Item 4.1.3 Replacement of ADP Equipment--First option, disagree; second option, disagree; third option, agree; and forth option, agree.

18. Item 4.2 Alternatives Eliminated From Further Consideration--ALMRS and GIS are not programs; they are support systems. If, in the long run, the workload is increased, then we should reconsider their use.

19. Item 4.2.1 All Alternatives Falling in the "Use of Non-ADP Resources" Category--Cutbacks are not the answer if ADP is to provide adequate services.

7. Item 3.1.1.1 Fully Centralized--In the past, the Denver Service Center has had the responsibility for training and hotline support, but apparently no longer wants that responsibility. The DSC had a function called the Customer Support Branch, but that was abolished in 1986. Nevertheless, the Service Center would be the most logical candidate to fill this important function.

8. Item 3.1.3.1 Matching Configuration Design to Organizational Design--(Paragraph 4, Page 3.11)--This is a good concept to make the system work in BLM.

9. Item 3.1.3.2 Flexibility--What about networking and sharing CPU's?

10. Item 3.1.3.4 Staffing Impact--To say that field offices must have appropriate personnel to support the computer system is an understatement. District Office and Resource Areas must also be included and we agree that a dedicated staff is required. The third paragraph does not mention training.

11. Item 3.1.4 Evaluation of Physical Computer and Data Distribution Alternatives--We feel that Alternative 3 is the best.

12. Item 3.1.4.3 Alternative 3 - Central (DSC) plus State Offices plus All Sites With Workload Over a Pre-determined Factor--We feel that Alternative 3 is best suited for BLM needs.

13. Item 3.1.5 Comparison of Alternatives--In the second paragraph, we would be cautious of end-users assuming operator responsibilities on a collateral basis.

14. Item 3.2 Level of CPU Specialization--In the first paragraph, we feel that multiple, specialized systems are needed and again, OA is not mentioned. The second paragraph mentions training and we support that idea. In the third paragraph, we feel it would be possible to go with full, open procurement, and that "product line" is a poor term. Procurement will never allow one product line.

15. Chapter 4, ACQUISITION ALTERNATIVES--The second paragraph does not include OA.

16. Item 4.1.2 Use of Other Sources of ADP Resources to Augment Existing Systems--The first paragraph mentions surplus equipment. We would like to mention that, in most cases, used equipment leads to higher maintenance costs than prices for new technology. Also, parts are very often difficult to find.

17. Item 4.1.3 Replacement of ADP Equipment--First option, disagree; second option, disagree; third option, agree; and forth option, agree.

18. Item 4.2 Alternatives Eliminated From Further Consideration--ALMRS and GIS are not programs; they are support systems. If, in the long run, the workload is increased, then we should reconsider their use.

19. Item 4.2.1 All Alternatives Falling in the "Use of Non-ADP Resources" Category--Cutbacks are not the answer if ADP is to provide adequate services.

20. Item 4.2.2 Those Options Involving the Use of Surplus Equipment--We concur with the opening sentence of the second paragraph, first sentence.

21. Item 4.4 Evaluation of Alternatives--We concur with Alternatives 2 and 3.

22. Item 4.4.1 Alternative 1--We do not agree with Alternative 1 as a good, long-term solution.

23. Item 4.4.3 Alternative 3--We feel that Alternative 3 is the only one which will be approved by DOI, GSA and OMB.

24. Chapter 5.0, STANDARDS--In the second paragraph, page 5-1, correct BLM IRMTAC Subcommittee to read BLM IRMTAC Committee. Also, "Office Automation Standards" should be included as an additional subpart.

25. Item 5.1.1 No Standard--We feel that the "No Standard" option is one to be considered. We can agree with the subpart entitled "Flexibility."

26. Item 5.1.2 Vendor Proprietary Operating System--Under subpart "Portability," too much weight is given to ALMRS. With ALMRS, we are talking primarily about data bases that should be transportable to different DBMS's.

27. Item 5.1.3 POSIX--On page 5-6, we are not sure what is being said of POSIX.

28. Item 5.1.4 Other Vendor Independent Operating System--Under subpart "Risk," any system with high risk should not be considered.

29. Item 5.1.5 Specified Proprietary Operating System--The first paragraph sounds plausible.

30. Item 5.1.6 Operating System Resolution--POSIX as a standard could have some serious operational problems. It sounds like a shell system to the different UNIX system.

31. Item 5.2 Spatial Graphics Standards--Under subpart 2, Graphical Kernal System, (GKS), GKS is not a spatial graphics standard. It is a graphics driver standard. We need graphic standards.

32. Item 5.2.3 Others--There was no talk about more specific standards, e.g. FGEF, etc. Under subpart "Risk," why not include it in GIS?

33. Item 5.3 Data Base Management System Standards--"No Standard," the first alternative listed, is a poor concept. The second alternative, "Vendor specific package," is a viable concept.

34. Item 5.3.1 No Standard--As mentioned above, this is a poor concept.

35. Item 5.3.2 Vendor Specific Package--This is probably the best option.

20. Item 4.2.2 Those Options Involving the Use of Surplus Equipment--We concur with the opening sentence of the second paragraph, first sentence.

21. Item 4.4 Evaluation of Alternatives--We concur with Alternatives 2 and 3.

22. Item 4.4.1 Alternative 1--We do not agree with Alternative 1 as a good, long-term solution.

23. Item 4.4.3 Alternative 3--We feel that Alternative 3 is the only one which will be approved by DOI, GSA and OMB.

24. Chapter 5.0, STANDARDS--In the second paragraph, page 5-1, correct ELM IRMTAC Subcommittee to read NLM IRMTAC Committee. Also, "Office Automation Standards" should be included as an additional subpart.

25. Item 5.1.1 No Standard--We feel that the "No Standard" option is one to be considered. We can agree with the subpart entitled "Flexibility."

26. Item 5.1.2 Vendor Proprietary Operating System--Under subpart "Portability," too much weight is given to ALMRS. With ALMRS, we are talking primarily about data bases that should be transportable to different DBMS's.

27. Item 5.1.3 POSIX--On page 5-6, we are not sure what is being said of POSIX.

28. Item 5.1.4 Other Vendor Independent Operating System--Under subpart "Risk," any system with high risk should not be considered.

29. Item 5.1.5 Specified Proprietary Operating System--The first paragraph sounds plausible.

30. Item 5.1.6 Operating System Resolution--POSIX as a standard could have some serious operational problems. It sounds like a shell system to the different UNIX system.

31. Item 5.2 Special Graphics Standards--Under subpart 2, Graphical Kernal System, (GKS), GKS is not a special graphics standard. It is a graphics driver standard. We need graphic standards.

32. Item 5.2.3 Others--There was no talk about more specific standards, e.g. PCCF, etc. Under subpart "Risk," why not include it in GKS?

33. Item 5.3 Data Base Management System Standards--"No Standard," the first alternative listed, is a poor concept. The second alternative, "Vendor specific package," is a viable concept.

34. Item 5.3.1 No Standard--As mentioned above, this is a poor concept.

35. Item 5.3.2 Vendor Specific Package--This is probably the best option.

36. Item 5.3.4 CODASYL--We do not feel that this is a very good alternative.

37. Item 5.3.5 DBMS Resolution--SQL is the best designation.

We appreciate the opportunity to comment.

LGarcia:cjs:6/4/87

SLM Library
Denver Federal Center
Bldg. 25, DC-521
P.O. Box 25047
Denver, CO 80225

36. Item 5.3.4 CODASYL--We do not feel that this is a very good alternative.

37. Item 5.3.5 DBMS Resolution--SQL is the best description.

We appreciate the opportunity to comment.

[Illegible]

BLM Library
Denver Federal Center
Bldg. 85, OC-521
P.O. Box 25047
Denver, CO 80225

Corporate Offices
1777 North Kent Street
Arlington, Virginia 22209
(703) 841-6000

Eastern Regional Office
Wall Street Plaza West
New York, NY 10006
(212) 618-0300

Midwestern Regional Office
20 North Clark Street
Chicago, Illinois 60602
(312) 269-0275

Rocky Mountain Regional Office
66 South Van Gordon Street
Lakewood, Colorado 80228
(303) 989-7065

Southwestern Regional Office
9800 Centre Parkway
Suite 950
Houston, Texas 77036
(713) 270-9095

Western Regional Office
Three Twin Dolphin Drive
Redwood City, California 94065
(415) 595-4600